ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. L. No. 3. NEW YORK, SATURDAY, JANUARY 19, 1907. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW
CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING
BOSTON
NEW ENGLAND OFFICE, ... 95 MILK STREET
LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS.

EDITORIAL:
- Electric Ignition of Gas Engines ... 95
- Directed Wireless Telegraphy ... 96
- Electricity Can Not Be Adulterated ... 97
- Rubber Production ... 97

Chicago Electrical Show Opened ... 98
Ohio Electric Light Association ... 98
The Progress of Electricity on Steam Roads in 1906 ... 98
The Central Colorado Power Company ... 99
American Society of Mechanical Engineers ... 100
The Heating Coefficient of Magnet Coils, by G. A. Lister ... 101
The Faraday Society ... 105
Some Data on the Simplon Tunnel Equipment, by B. F. Hirschauer ... 106
Electric Gold Dredge at Ruby, Mont ... 108
Practical Testing of Induction Motors, by R. E. Hellmund ... 108
Merchants' Association Passenger Rates ... 110
The Helion Filament Incandescent Lamp ... 111
Exhibit of Electrical Appliances at the Seventh Annual Automobile Show ... 113
National Electric Light Association Committee to Formulate Model Contract and Specifications for Street Lighting ... 113
Demonstration of the Telharmonium ... 113
Illuminating Engineering Society ... 114
Meeting of the Street Railway Association of the State of New York ... 115
Advantages of Overhead Trolley in Winter ... 115
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE ... 116
METHODS OF GETTING NEW BUSINESS ... 118
INDUSTRIAL SECTION:
- "Transite" Fireproof Asbestos Doors ... 121
- Centrifugal Pumps ... 121
- Experiences with a Tirrill Regulator in the Electricity Works at Wels, Austria ... 122
- Annual Meeting of the Electrical Salesmen's Association ... 123
- Cooper Hewitt Lamps in a Steam Room ... 123
- A Sample Board of Enclosed Fuses ... 124

CURRENT ELECTRICAL NEWS ... 125
RECORD OF ELECTRICAL PATENTS ... 131

Copyright, 1907, by Electrical Review Publishing Co.

ELECTRIC IGNITION OF GAS ENGINES.

The ignition problem in gas engines and other motors of the internal-combustion type has always been one of considerable importance. Various plans have been tried, with more or less success. Electric ignition has played an important part in this work, and has, on the whole, given the most satisfactory results for all classes of work. Nevertheless, electric ignition has not been free from troubles of its own, and many plans have been tried to render this little accessory device perfectly trustworthy. For example, an incandescent wire may be used, or an electric spark. If the latter plan be adopted, dependence may be placed upon a low-voltage discharge of comparatively large intensity, what is called a "thick" spark, or a smaller current discharge at higher voltage. All these plans have advantages, yet none of them is entirely free from trouble. The problem has even attracted some high scientific skill, yet one can not say to-day that it has been solved in an entirely satisfactory way, for a failure of the ignition system seems to be one of the most frequent causes for the breakdown of automobiles. Whether the fault lies with the builders of the automobile engine, who may put more dependence upon their own ideas and less upon scientific suggestions, or whether it be true that the conditions surrounding the discharge gap in the cylinder render the scientific suggestions, based on outside phenomena, useless, remains to be seen. In fact, there seems to be an excellent opportunity for some one who will make a thorough investigation of the whole problem, so as to put it upon a sound basis.

There should be no difficulty in producing an electrical discharge at any given instant at any given intensity within the cylinder. If this be done there seems to be no reason why the explosive mixture, if it has been properly mixed, should not be ignited.

Some work was done recently in this direction by Messrs. H. Topham and H. G. Tisdall, during a test of a gasolene engine which they were making. One point of interest investigated was the effect of an external spark-gap upon the action of the igniter. It has been known for a long time that if a second gap be introduced in the ignition circuit outside of the cylinder that there is less likely to be failure. This was shown to be the case in the work referred to above, and it was found that it was probably due to the fact that under continuous working the insulation of the plug becomes heated and thereby a comparatively good conductor, so that the current, instead of jumping suddenly across the gap as a spark, will leak across the insulation and thus prevent the necessary spark from being produced in the gap. It was found that by heating the spark

plug by means of a gas flame that it failed to work as soon as the porcelain bushing became red hot, but began again when this was allowed to cool. The effect of the external gap is to prevent a leakage across the porcelain, so that when a discharge takes place the rush of current will be forced across the gap. There would probably be some benefit in this if, as may be the case, the discharged electrodes become coated with soot. Leakage would be apt to take place, but a sudden violent discharge across the gap would have, more or less, the nature of an explosion and tend to clear the gap. This suggests also that the cooling of the plug by means of circulating water might increase its reliability. It was found from the above-mentioned test that the resistance of a porcelain sleeve was about 1,000 megohms cold, but fell to less than one megohm at a red heat. It should not require much cooling to maintain the resistance at a point at which the leakage effect should become negligible.

Another point investigated in these tests was the effect of the speed of the engine on the spark time. Setting the igniter to give a spark at a certain point during the revolution of the flywheel, it was found that at first, under normal conditions, there was an apparent advance of about forty degrees in the spark. This was due to the rebound of the spring switch of the primary of the induction coil, which thus opened the circuit before it was lifted by the cam. When this defect was remedied there was a retardation of about thirty degrees in the discharge, corresponding to nearly one-tenth of the stroke of the engine. Similar behavior, no doubt, occurs in many cases in actual practice, so that one can not say just what the ignition system is doing. A thorough study of the whole problem would, no doubt, suffice to clear away much misunderstanding and assist in producing an ignition system which could be called reliable.

DIRECTED WIRELESS TELEGRAPHY.

During March of last year a paper was presented to the Royal Society, of London, by Mr. William Marconi, detailing some results with directed wireless telegraphy which he obtained by means of an antenna, part of which was stretched horizontally over ground. Later in the year Dr. J. A. Fleming offered a theoretical explanation of the directed action of such horizontal antennæ in a note read before the same society. This note was discussed briefly in the ELECTRICAL REVIEW for July 29. At the same time another explanation of the phenomenon was pointed out. This considers the horizontal antenna as constituting really two oscillating systems differing in phase. The vertical portion forms one of these, and the horizontal wire, acting with the earth as a condenser, forms the other. The latter is, of course, displaced from the former, and the oscillations taking place in it will differ in phase. In other words, the results obtained resemble, but they are not identical with, those which could be obtained by means of two vertical antennæ properly placed and suitably tuned. Under proper conditions these two antennæ would reenforce one another in the plane containing them, while interference, to a greater or less extent, would take place throughout other angles.

More recently a fuller paper has been presented by Dr. Fleming before the Physical Society, of London, which discusses the reasons for the unsymmetrical action of a bent oscillator and gives the results of a number of experiments, conducted, however, on a small scale. These experiments agree with those conducted by Mr. Marconi, but the curves obtained are more irregular and distorted. The smooth figure 8 curve which might be expected is not seen. The results also agree with the previous work, indicating that the greatest reenforcement takes place in the plane containing the antenna, but in the opposite direction to which it points.

Dr. Fleming offers a simple explanation of this action. Assuming a rectangular oscillating circuit in which the current at all points is equal at the same time, points in the magnetic field thus set up may be obtained at which the forces are equal and in the same direction, and these points, when they lie in the plane of the rectangle, will be equally distant from its centre. If, now, one side of this rectangle be paralleled by a single conductor which carries a current exactly opposite in phase to that of the side, the effect will be to weaken the magnetic field on that side of the rectangle which has been paralleled by the wire and to strengthen it on the other side, because the magnetic forces set up by the current in the single wire will oppose that of the side of the rectangle lying near it and assist that of the far side. Assuming, then, that the current in this wire is just equal to that in the rectangle, it will neutralize the effect of the near side of the rectangle so that it may be neglected, and a loop is obtained which seems to resemble the bent antenna which employs the earth for the third side of the loop; an unsymmetrical magnetic field will be set up which will be strongest in the plane of the antenna but on the opposite side from the horizontal part.

This explanation does not seem to be entirely satisfactory, for in the first place the current will not be the same at all points of the oscillating system at one instant. This objection is pointed out by Dr. Fleming, but he says that to allow for it greatly complicates the system. However, even overlooking this fault, objections may still be made to the reasoning, for by paralleling three sides of the rectangle by three wires, in a way similar to that suggested by Dr. Fleming, the effect of these wires will be wiped out, and reasoning will still call for an unsymmetrical field, although we have by analogy a single vertical antenna which should give a uniform circular field. Replying to this criticism, it might be stated that an unequal distribution will be found if the measurements are made from the centre of the rectangle, instead of from the antenna. But the same criticism can be made of Dr. Fleming's explanation. He speaks of the centre of the system without in any case defining it, and from his diagrams, as well as from the abstracts of the paper which have as yet been seen, the measurements seem to have been made, not from the centre of the horizontal portion of the antenna, but from the vertical portion. Assuming that this has been the case, part, at least, of the ununiform distribution may be explained. For instance, in one case the horizontal portion of the antenna was fifteen feet long, while the distance at which the intensity of the electric force set up in

various directions was measured was only 138. There is a difference here of nearly ten per cent, which would account for a difference of ten per cent in the intensity of the field, assuming that it varies inversely as the distance only. As the variation is probably greater than this, a still greater difference might be expected. Actual readings showed that the intensity, measured in the direction of the horizontal antenna, was about eighty-seven per cent of that measured in the opposite direction.

While part of the effect which was found might be explained in this way, this will not account for the very distorted curves found from experiment. It should be mentioned, however, that in these experiments a capacity was attached to the free end of the horizontal antenna, which gave it a period of oscillation corresponding to a somewhat greater length. The length of the wave employed is about 100 feet, which corresponds to a total antenna length of about twenty-five feet. If this should have the effect of displacing the centre of the system still more towards the free end of the antenna, it would bring the results obtained still closer to what might be expected, upon the assumption that this system is similar to the two separate vertical antennæ mentioned above. Moreover, it should be noted that attaching a capacity to the free end of the antenna might, according to the other explanation, be expected to give more pronounced directive action. It should be noted that while the maximum intensity of wave was found to be in the plane of the antenna, the minimum was not at right angles to this, but at an angle of about 105 degrees from the direction of the maximum. This result agrees with Mr. Marconi's work. A similar result would be expected if two separate antennæ were employed, of different radiating powers. While the analytical explanation of the directed action of the horizontal antenna may be satisfactory as given, a simpler one which could be readily understood and which would give some idea of the forces brought into play, would be very acceptable.

ELECTRICITY CAN NOT BE ADULTERATED.

One of the best points for the central station solicitors to bring home to prospective customers is the fact that it is absolutely impossible to adulterate electricity, even if a company desired to do it. This is not true of gas, water or many of the other necessary public services. The quality of the service given by different central stations may vary in respect to the evenness of the voltage and the continuity of the supply, but the fact remains that the customer who buys electric current by meter pays for electric current and for nothing else. There are no inferior grades of electricity. Of course, meters go wrong at times, but the number of inaccurate instruments in service is a surprisingly small proportion of the whole.

This point is well worth pressing home when complaints begin to be voiced among consumers as to the poor quality of the gas, and at this time of year capital can be made out of the inferior gas service supplied in many communities. There is no better time to press home the value of central station power and light than when the gas consumer is getting dissatisfied with the service for which he pays.

RUBBER PRODUCTION.

A recent report from United States Consul G. E. Anderson, at Rio Janeiro, quotes from a message of the governor of Para, Brazil, regarding the future of the Brazilian rubber industry. The necessity for planting rubber trees and cultivating them as an agricultural enterprise in the Amazon valley is earnestly urged, for only in this way can the rubber industry be protected and placed upon a firm and lasting basis.

This report also gives the latest figures showing the production of rubber in the Amazon country. During the year ending June, 1906, 75,352,395 pounds of rubber were shipped from the Brazilian ports of Para and Manaos, and the Peruvian port of Iquitos. Of this amount something over 37,000,000 pounds was fine rubber, the rest being medium and poorer qualities. Of the total amount shipped a little over 44,000,000 pounds went to Europe, and 31,000,000 pounds were brought to this country.

This information is interesting, taken in connection with a brief discussion of the rubber situation which is given on another page of this issue. This is from a report by Mr. J. C. Willis, of the Ceylon rubber exhibition held during the past summer. It is said that there are in Ceylon over 100,000 acres which have been planted in rubber, and in the Malay peninsula about half as much more. It is estimated that Mexico has about 100,000 acres planted in rubber, making in all about 275,000 acres, which should produce before long about one-quarter of the probable world's consumption. The results from these plantations seem to have been so successful that the work might be enlarged, as this would not only render us less dependent upon the natural forests, but would stimulate the Brazilian rubber-producing states to begin artificial cultivation there.

An interesting part of Mr. Willis's report deals with the methods of preparing rubber which have been developed in Ceylon. Instead of curing the rubber by crude methods such as those employed in Brazil, scientific methods have been devised which produce a cleaner and purer article. Moreover, by mixing the vulcanizing materials and the coloring matter with the latex, a material is produced which is much more homogeneous than can be secured by the treatment of cured rubber, and the same plan—that of adding other materials before coagulation—makes possible a number of new and valuable products which have the wearing qualities and strength of rubber, although they contain but a small proportion of it. It would seem that more progress has been made in such matters in Ceylon than is possible under the conditions existing in Brazil, but it might be well to follow the work there closely, with a view of benefiting from it. Some of the processes which have been found successful in Ceylon might prove valuable even under very different conditions.

Any reference to the production of rubber always brings to mind the unique position occupied by this material. For many purposes it is indispensable, and it would be much more widely used if a larger production were available. So far the science of chemistry has not succeeded in devising a substitute for this material, though time and again the desirability of doing so has been urged.

Chicago Electrical Show Opened.

(Special Telegram to the Electrical Review.)

CHICAGO, ILL., January 14.—The second annual show of the Chicago Electrical Trades Exposition Company opened Monday evening, January 14, at eight o'clock. There were probably ten thousand persons present and much enthusiasm was shown. The interest was well maintained. The exhibitors and management have been caused much expense and inconvenience by the unreasonable demands of labor organizations. Heroic work to-day made possible the opening in very good shape. The Coliseum is elaborately decorated and brilliantly lighted. Among the more prominent exhibitors are the General Electric Company, showing the remarkable effect of high candle-power lamps and Holophane reflectors, a feature of the exhibit being eighty-five-candle-power 105-watt tungsten lamps made in an American factory by American methods; Allis-Chalmers Company; Automatic Electric Company; American Steel and Wire Company; Central Electric Company; Frank B. Cook; Joseph Dixon Crucible Company; Electric Service Supplies Company; Electric Storage Battery Company; Fort Wayne Electric Works; Gould Storage Battery Company; National Electric Lamp Association, Stromberg-Carlson Telephone Manufacturing Company; Wagner Electric Manufacturing Company; Western Electric Company; Westinghouse Companies; National Battery Company; American Electrical Novelty Company; American Sewer Pipe Company; Albert and J. M. Anderson; W. N. Matthews and Brother; National Carbon Company; J. L. Schureman Company; Shelton Electric Company and C. H. Thordarson. The Chicago Edison and Commonwealth Electric companies make an extensive display of light, heat and power apparatus. A. A. G.

Ohio Electric Light Association.

The executive committee of the Ohio Electric Light Association held its mid-winter meeting in Columbus, Ohio, January 10. The committee at that time selected Toledo, Ohio, as the place for the thirteenth annual convention of the association and fixed the date as August 20, 21 and 22, 1907. The programme will be entirely by central station men and its features particularly attractive to central stations.

In accordance with the action taken at the last convention, the central station men of Indiana will be invited to be the guests of the Ohio association on the occasion of this convention.

The Progress of Electricity on Steam Roads in 1906.

At a recent meeting of the Western Society of Engineers Bion J. Arnold, in his presidential address discussed the progress made in the electrification of steam railroads in 1906.

On a former occasion, in September, 1904, during the International Electrical Congress, at the joint meeting of the Institution of Electrical Engineers, of Great Britain and the American Institute of Electrical Engineers, as retiring president of the latter body, Mr. Arnold spoke upon the "Electrification of Steam Railroads," and made certain predictions which have been fairly closely followed since. After quoting from that address his idea of the way in which electrification of steam railroads would come about, Mr. Arnold described the work which is now being carried out and which confirms his forecast. The work was expected to begin at the large city terminals when local conditions made the change necessary. This would lead to an extension of the system and the roads would become interested in competing electric lines. Then a fast electric freight service would be developed which would eventually become so important that the through freight traffic by steam locomotives, though at present cheaper, would in time, as cost of coal increases, grow less, until those roads operating an electric passenger service would ultimately use electricity exclusively.

Previous to 1904 the officials of the steam railways of the country had paid but little attention to the subject of electricity, but were then beginning to realize the inroads that were being made upon their local traffic by the interurban roads. This caused the more progressive ones among them to begin carefully to investigate the claims of the advantages of electric traction, with the result that at that time there were either contemplated, or well under way, a number of important electrical installations, which could be credited to the favorable decisions of steam railway officials.

As confirming the prediction then made, to the effect that the steam railroads would acquire the electric roads paralleling them, attention was called to the fact that according to published reports the New York Central & Hudson River Railroad Company has since then, in addition to practically completing its great electric terminal in New York city, either purchased outright, or acquired indirectly the controlling interest in most of the interurban roads paralleling its lines between Albany and Buffalo, and the New York, New Haven & Hartford Railroad has recently acquired practically all the interurban roads which compete with it in its territory. The Erie Railroad is, in addition to its preparation for the electrification of its terminals in the vicinity of Jersey City, now equipping thirty-four miles of track extending southeast of Buffalo, thus retaining traffic which might have been taken from it by the construction of competing interurban lines.

In like manner the Pennsylvania Railroad system, in addition to the electrification of its great terminal system in the vicinity of New York, is gradually electrifying the Long Island Railroad system.

The New York, New Haven & Hartford Railroad Company is also going to great expense in the electrification of its line from New York city to Stamford, Ct., a distance of thirty-one miles, with reasonable probability of gradual extension of electric traction over its system.

These few examples, together with the electrical operation of the great Simplon tunnel, by means of which the traveler will be carried from Switzerland into Italy without the annoyance due to obnoxious gases emitted from the steam locomotives, are sufficiently impressive to emphasize the correctness of the lines of development outlined in 1904, involving, as they do, an expenditure of approximately $100,000,000 for electrical equipment, and a collateral investment of some $300,000,000 more.

In addition to these general types there are now under construction, or contemplated construction, many special installations adopted for various reasons, such, for instance, as the Saint Clair tunnel of the Grand Trunk Railway system, extending from Port Huron, Michigan, to Sarnia, Ontario, wherein steam locomotives will soon be abandoned and trains operated electrically.

The equipment of the Cascade division of the Great Northern Railway, over the Cascade mountains, a distance of about 100 miles, although not yet definitely decided, is another notable example of the contemplated application of electricity to steam roads. Its equipment would eliminate the use of steam locomotives now operating over a tortuous piece of road, and through a long and difficult tunnel.

Electrification is also contemplated upon a division of the Southern Pacific Railway, through the Sierra Nevada mountains, for the purpose of eliminating the difficulties due to tunnel operation, and of increasing the capacity of the road, which is now limited by the size of the present steam locomotives.

Mr. Arnold exhibited a number of lantern slides showing the work being done by the roads mentioned.

The Central Colorado Power Company.

The Central Colorado Power Company, which has recently been incorporated under the laws of the state of Colorado, has an authorized bond issue of $20,000,000 and a stock capitalization of $7,500,000 of preferred stock and $15,000,000 of common stock. The first issue of bonds consists of $9,000,000, which have already been sold, and the proceeds of these bonds will be used to build the first power plants, which will have an aggregate capacity of 30,000 horse-power.

The company has acquired water rights and other properties, the core of the situation, however, consisting of water rights on the Grand river. It is proposed to construct two large plants on this river, one at Gore Canon and one near Glenwood Springs. In addition to these rights on the Grand river, other very important water rights and properties have been secured with a view to development later. In order to provide funds for the first development, which will consist of plants sufficient for 30,000 horse-power, $9,000,000 of bonds of the company have been sold.

The board of directors of the company for the first year are as follows: D. H. Moffat, Charles M. MacNeill, J. A. Hayes, Leonard E. Curtis, Henry Hine, Thomas F. Walsh, all of Colorado; Hon. Myron T. Herrick, of Cleveland, Ohio; J. R. McKee, S. Z. Mitchell, E. R. Coffin, William P. Bonbright, all of New York; George L. Peabody, Copley Amory, of Boston.

The following officers of the company have been elected:

President—Hon. Myron T. Herrick, Cleveland, Ohio.

Vice-presidents—J. R. McKee, New York; S. Z. Mitchell, New York; Leonard E. Curtis, Colorado Springs; Henry Hine, Colorado Springs.

Secretary and treasurer—Leonard E. Curtis.

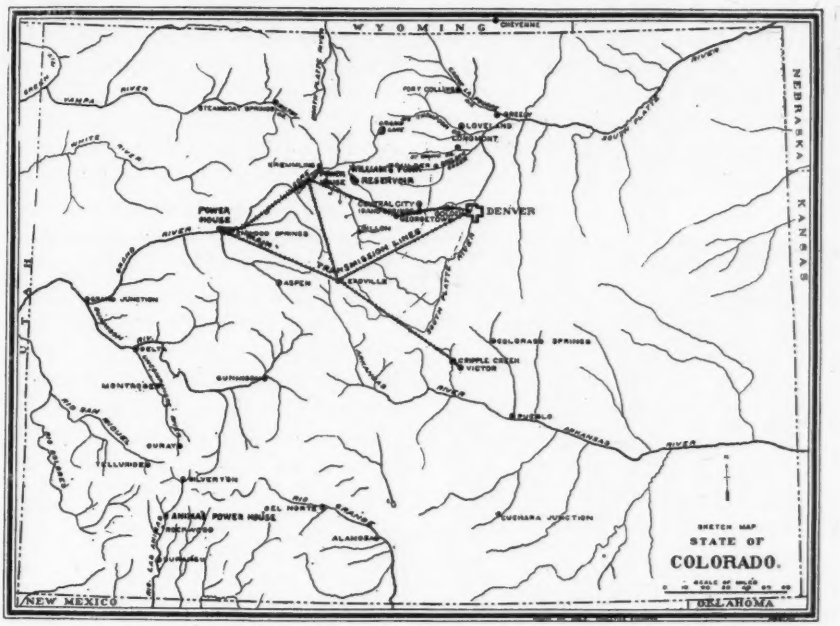
General managers—Curtis & Hine, Colorado Springs.

The organization has been perfected and active work is now in progress on the plants at Gore Canon and Glenwood Springs.

The organization will include George B. Tripp, formerly manager of the Colorado Springs Electric Company, P. T. Hanscom, electrical engineer, formerly at the head of the power and mining department of the General Electric Company, and R. McF. Doble and F. C. Finkle, consulting hydraulic engineers.

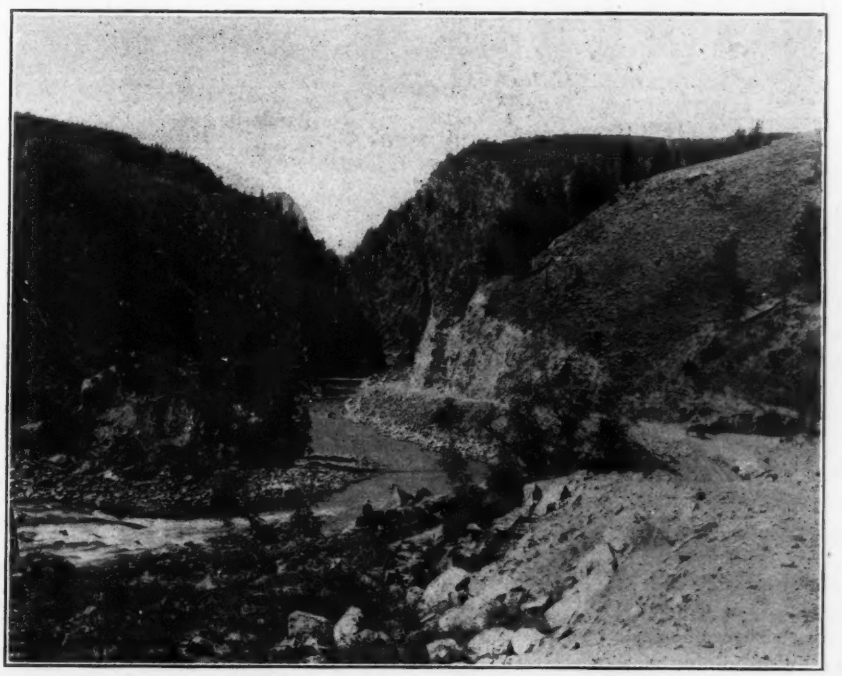
The first developments which it is proposed to complete will have a capacity of 30,000 horse-power, and it is expected that at least half of this will be in operation in from fifteen to eighteen months.

The first plants to be built are in the centre of a territory of 50,000 square miles, which can readily be supplied from the two plants, with transmission lines of moderate length. This territory includes Denver, Boulder, Gilpin and Clear Creek counties, Leadville, Cripple Creek, and, in fact all the mining districts, cities and towns from Grand Junction on the west to Denver on the east, and Wyoming state on the north to Pueblo on the south.



SKETCH MAP OF THE STATE OF COLORADO, SHOWING MAIN TRANSMISSION LINES OF THE CENTRAL COLORADO POWER COMPANY.

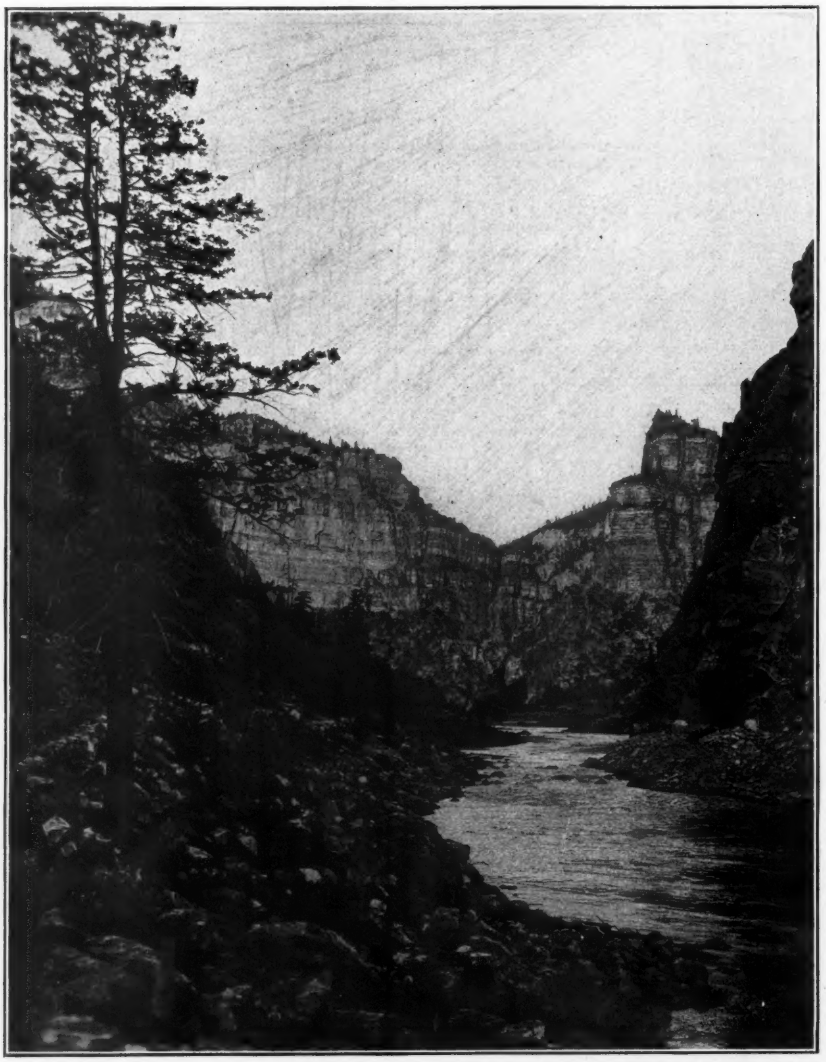
The present plans contemplate further developments as rapidly as the market for power demands them, which will have an aggregate capacity of 50,000 additional horse-power. The plans for this work are already completed and the company has financial backing which will enable it to construct these plants as rapidly as the market for power demands them.



DIVERGENCE OF GRAND RIVER, COLORADO, AT GORE CANON.

As in a very large part of this district the cost of making power by steam must

necessarily always be high, it is believed that the supply to these places of large amounts of power at prices much below the cost of steam power will be of very great benefit to them all. The policy of the company will be broad and liberal, and experience with similar plants elsewhere has demonstrated that the introduction of electric power at a moderate price, with all of its advantages of simplicity and flexibility, is a very potent agent in assisting in the development of enterprises of all kinds. The company will fix rates that will encourage business and investment of capital in mining, milling, traction, lighting, manufactories and other enterprises.



Divergence of Grand River, Colorado, at Glenwood.

The work undertaken is one of great magnitude, and construction will continue over a period of a number of years. At Gore Canon it will be necessary to construct a tunnel four miles long for conveying the water from the intake in the river to the power-house. The water conveyed through this tunnel will be dropped through pressure pipes to the wheels with a head of about 350 feet. At Glenwood, similar construction will be employed, but the tunnel there will be about ten miles long, and the head obtainable 400 feet. Immense power-houses of the most modern and up-to-date construction will be built, and the transmission lines constructed to convey the energy from the power-houses to the various points of use at a pressure of probably 80,000 volts. The present plans contemplate the construction of about 300 miles of such lines. These lines will consist of steel towers and copper cables, and will be built to withstand the severe conditions of climate and weather prevailing throughout the mountainous regions, so as to insure continuity of service.

The construction of the long tunnels, which will be twelve feet by fifteen feet in size, is, of course, a very expensive undertaking, but, when once completed they will be permanent and the plants will not be subject to the interruptions common to plants of this character where wooden flumes and open canals are used.

Taken as a whole this is the largest undertaking of the kind ever started, and if the plants are properly constructed and managed, it should prove profitable to the company and of inestimable value to the state of Colorado as a whole. It is prophesied by those who are making a most careful study of the subject that it will not be long before the trunk lines of railroads will be operated over the Continental Divide by electric power, and the establishment of these great power plants will undoubtedly bring this about more quickly than if the railroads had to depend upon making their own power. In view of these facts, Colorado is to be congratulated upon an enterprise of this character, which brings such a vast amount of outside capital into the state to be spent in a way which can not help being of great benefit to the state at large.

American Society of Mechanical Engineers.

A meeting of the American Society of Mechanical Engineers was held in the auditorium of the engineering societies' building, January 8, to listen to an address by Frederick P. Fish, president of the American Telephone and Telegraph Company, upon the subject, "The Ethics of Trade Secrets." An invitation had been issued to the American Institute of Electrical Engineers to attend this meeting.

It was announced that while the meeting was the first one to be held in the new building, and although the other organizations would begin to hold their meetings there, that the formal opening of the building would not take place until April, as had been stated previously. Since, however, the various auditoriums have been completed, it seemed desirable that they should be utilized, and the different societies obtain the benefit of suitable places for meeting. After the address those in attendance inspected the building and the various quarters of the different societies.

An abstract of Mr. Fish's address will be presented in an early issue of the Electrical Review. The subject was introduced by a brief historical review and then the legal side was explained.

THE HEATING COEFFICIENT OF MAGNET COILS.[1]

BY G. A. LISTER.

The heating coefficient as applied by the designer of electrical machinery is expressed by—

$$C_h = S_w . t.$$

where—

t = Mean final temperature rise in degrees centigrade.

S_w = Coil surface in square centimetres per watt dissipated.

C_h = Heating coefficient.

The mean final temperature rise is given by the difference between the mean temperature of the coil when it has reached a steady value, θ_2, and the temperature of the surrounding air, θ_1. The method of measuring the temperature of the coil by a thermometer is unsatisfactory. The safer way is to determine the temperature by calculation based on the observed increase of resistance. This gives the mean temperature throughout the coil, and is the method which has been used in the tests here recorded. The actual resistances are conveniently determined by means of a voltmeter and ammeter.

The ratio of the maximum to the mean temperature of a coil varies with its dimensions and design, and on the conditions under which it is worked. The following average values of this ratio are taken mainly from Rayner's report to the Engineering Standards Committee.[2] Rayner's tests were made on machines ranging from 25 to 500 kilowatts.

Conditions.	Ratio. Max. Temp. / Mean Temp.
Stationary coil without core.....	1.12
Coil in place on machine.....	1.17
Coil in place on machine running light	1.15
Coil in place on machine fully loaded	1.175

Very few values are over 1.2, and this is consequently a safe figure to employ when estimating the maximum temperature of the field coils of fully loaded machines.

The Surface per Watt—As has been stated, there is a diversity of opinion as to what portion of the coil surface should be taken in expressing the surface per watt, or the surface to be provided per watt dissipated in the coil. Tests show a slight increase in the temperature rise when the coil is placed on the core, this small effect occurring both with taped coils and with coils wound on a metal former. In view of the fact that the temperature rise differs so very little in the two cases, it seems preferable to consider the total surface of the coil when dealing with the surface per watt, and to use a "heating coefficient" which will combine the effects of radiation, conduction and convection.

The heating coefficient, although usually quoted as a single figure and called the heating constant, is certainly not constant even for the same machine. It varies with the speed and with the load. In different machines it will also vary with the nature of the surface of the coil, the method of securing the coil to the machine, the ventilating properties of the rotating armature, and generally with the design of the machine. If all these conditions remain constant it will still be found that the coefficient varies with the final temperature attained by the coil.

The following curves, Figs. 1 to 7, show the variation of the temperature rise with the watts absorbed for various types of coils and under varying conditions. In cases where it should prove useful, the heating coefficient has also been plotted.

Four conditions have been considered:

1. The coil supported in air.
2. The coil in place on the machine with the machine stationary.
3. Machine running light at normal speed.
4. Machine running fully loaded at normal speed.

Some of the results recorded have been taken from previous papers. In each such case the points are plotted in a distinctive manner. Particulars of the coils, so far as they are available, will be found in Table II, and also full references to the original papers.

A few words of explanation are necessary in reference to my own tests. The resistance of the coil at zero centigrade was calculated by using the standard temperature coefficient of 0.428 per cent increase of resistance per degree centigrade rise. All temperature rises were then calculated from this basis. Each measurement of final temperature was made after the coil had been carrying current for a period averaging about ten hours, thus insuring that perfectly steady temperature conditions had been reached. Full particulars of the six coils tested will be found in Table I. The coils have been numbered I to VI, using Roman figures. In every instance the figures for the watts per square centimetre are based upon the total surface of the coil.

1. Coil Supported in Air—In my tests the coils were supported on three points, at a height of from four inches to six

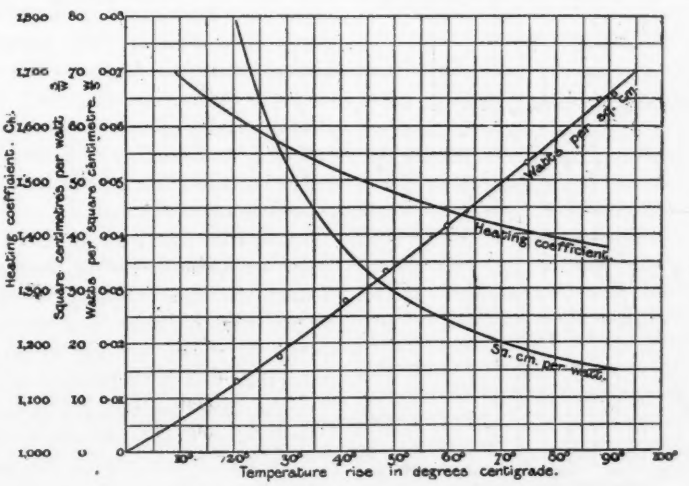


FIG. 1.—COIL NO. 1 SUPPORTED IN AIR.

Small coil covered with two layers of tape and varnished. Total surface, 960 sq. cm. For details of coil see Table I.

Since the greater part of the cooling effect is due to radiation, it is not surprising that field coils should follow to some extent the law of radiation. In 1879, Stefan[1] showed that radiation was proportional to the fourth power of the absolute temperature, and this has since been verified, and is recognized as Stefan's law. If radiation only had to be considered we should have—

$$k = S_w (\theta_2^4 - \theta_1^4),$$

where k is a constant known as the "constant of radiation."

The experimental heating curves of field coils show characteristics of this law (see Fig. 1), but unfortunately the disturbing and uncertain effects of conduction and convection render it impossible to state a general equation, such as the above.

[1] Abstracted from a paper read before the Birmingham local section of the Institution of Electrical Engineers of Great Britain, December 12.

[2] E. H. Rayner, "Report on Temperature Experiments carried out at the National Physical Laboratory;" Journal of the Institution of Electrical Engineers, 1905, p. 618.

[1] Wien. Akad. Ber., 1879, lxxix, pp. 391, 428.

inches above the surface of a table. Four coils were tested in this manner, and the results will be found plotted in Figs. 1 to 3. The actual observations are shown. Points obtained from published data are also plotted.

The results obtained on Coil I are given separately in Fig. 1, the watts dissipated per square centimetre, the square centimetres per watt, and the heating coefficient being all plotted against the temperature rise. The whole of the observations are plotted in Figs. 2 and 3; the temperature rise against the watts per square centimetre in Fig. 2, and the heating coefficient against the temperature rise in Fig. 3.

These results show clearly the effect of the covering of the coil on its heating.

Coil IV is that of a 100-brake-horse-

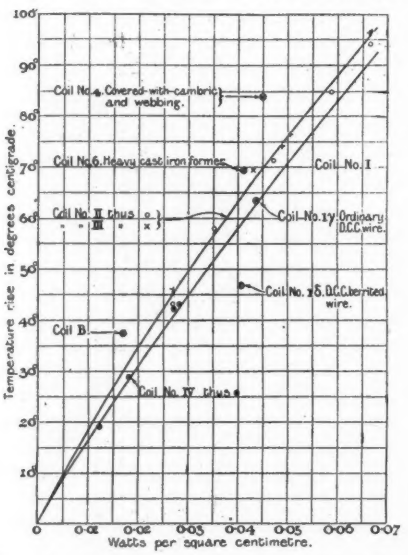

Coil No. 4. Covered with cambric and webbing.
Coil No. 6. Heavy cast iron former.
Coil No. I
Coil No. II thus o
Coil No. III " x
Coil No. 1γ. Ordinary D.C.C. wire.
Coil No. 1δ. D.C.C. berrited wire.
Coil B
Coil No. IV thus •
Temperature rise in degrees centigrade.
Watts per square centimetre.

FIG. 2.—TEMPERATURE RISE OF COILS SUPPORTED IN AIR.

	Total Surface.
Coil No. I, covered with two layers of tape	960 sq. cm.
Coil No. II, covered with mica and tape	1,075 sq. cm.
Coil No. III, heavily insulated with mica and taped	2,530 sq. cm.
Coil No. IV, wound on sheet-iron former	2,100 sq. cm.

For details of these coils see Table I.

power motor tested by Rayner. This was covered in an unusual manner with three layers of varnished cambric and four thicknesses of boot webbing.

Coil I was covered only with varnished tape.

Coils II and III gave almost identical results. In each case a considerable amount of mica was used, and this was covered with tape and varnished. Coil II was an ordinary field coil, and Coil III was one belonging to a stationary armature of a high-tension alternator. The latter was heavily insulated with mica around the embedded portion of the coil.

Coil IV was wound in a sheet-iron former with the outside cylindrical surface left uncovered. The results are nearly identical with those obtained for the plain Coil I.

An interesting fact is the remarkably small temperature rise of Coil Iδ. It was identical with Iγ, except that it was wound with double cotton covered berrited wire. This point was referred to by A. F. Berry in the discussion on Rayner's paper.[1] He stated that such enamels would stand high temperatures, and suggested their use as a means of reducing the cost of production. Engineers generally would welcome further information respecting such coils from those in a position to give it.

2. Coils in Position on Machine—Machine Stationary—The variation of temperature rise with watts per square centimetre is plotted in Fig. 4, and two typical heating coefficient curves in Fig. 5. Fig. 4 gives results on a greater variety of coils than Fig. 2, more data and tests being available. A comparison of the two sets of curves, however, such as may be obtained at a glance by placing a tracing of Fig. 2 over Fig. 4, is instructive, as showing the effect of the iron core upon the heating of the coil.

Coil I of Fig. 2 and Coil VI of Fig. 4 are comparable, being constructed in much the same manner. At a temperature rise of fifty degrees centigrade, Coil VI shows ten degrees greater heating than Coil I. This must be partly due to the fact that Coil VI is considerably larger than Coil I, and also to the general tendency of coils which are made to fit loosely over the core in the usual manner to show a slightly greater temperature rise when placed in position.

Also, tests on Coil IV are plotted in both figures, and the curves show that at fifty degrees centigrade the coil heats about three degrees more on the core than when supported in air. This coil is wound on a special former, the end plates of which project inward about one-quarter inch, thus leaving a clear but practically unventilated space between the main part of the former and the core.

Coils Iγ and VI also show slightly greater heating when placed in position on the core. In all cases, however, this increase of temperature rise is small, and the results justify the system of basing the heating coefficient on the total surface of coil and former.

Coil V shows the least heating. It was the smallest coil tested, and was wound on a zinc former fitting very closely to the core. I think it likely that the method of making the former of metal and fitting it very closely over the iron core may cause the coil to run cooler when placed

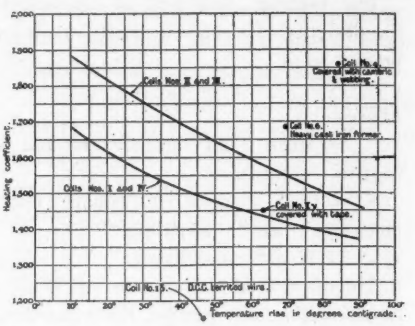

Coils Nos. II and III.
Coil No. 6. Heavy cast iron former.
Coils Nos. I and IV.
Coil No. 1γ. covered with tape.
Coil No. 1δ. D.C.C. berrited wire.
Heating coefficient.
Temperature rise in degrees centigrade.

FIG. 3.—HEATING COEFFICIENT OF COILS SUPPORTED IN AIR.

	Total Surface.
Coil No. I, covered with two layers of tape	960 sq. cm.
Coil No. II, covered with mica and tape	1,075 sq. cm.
Coil No. III, heavily insulated with mica and taped	2,530 sq. cm.
Coil No. IV, wound on sheet-iron former	2,100 sq. cm.

in position than when freely supported in air. Coil VI (without former) was practically only in contact with the core at the corners. As will be seen from Table I, the motor Coil VI was wound with larger wire than the generator Coil VI*a*,

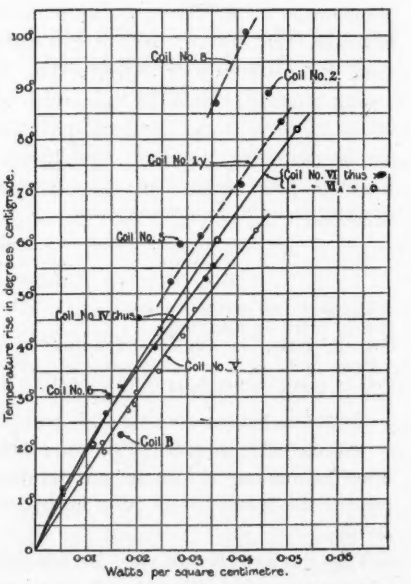


FIG. 4.—TEMPERATURE RISE OF COILS IN POSITION, MACHINE STATIONARY.

	Total Surface.
Coil No. IV, wound on sheet-iron former	2,100 sq. cm.
Coil No. V, wound on zinc former	1,815 sq. cm.
Coil No. VI, no former, very little covering	3,400 sq. cm.
Coil No. VI*a*, no former, very little covering	3,400 sq. cm.

For details of these coils see Table I.

and the results obtained, taken partly on one machine and partly on the other, show experimentally by their close agreement that the heating coefficient does not depend on the size of the wire. The curves

[1] Journal of the Institution of Electrical Engineers, 1905, p. 704.

also show the tendency of large coils to heat more than small ones.

A comparison between the figures which I have derived from Rayner's tests which Rayner tested was possibly of a much more enclosed design than the machine illustrated to which Coil VI belonged.

armature. It probably varies also to an extent which is quite appreciable with the air-gap, the ratio of pole surface to pole pitch, and the design of the armature

TABLE I.

DETAILS OF THE COILS TESTED AT THE BIRMINGHAM UNIVERSITY.

No. of Coil.	Type of Machine.	Capacity of Machine.	Normal Speed in Revs. per Min.	No. of Poles.	Excitation Voltage.	Size of Core in Cm.	Average Section of Coil in Cm.	Covering of Coil.	Former.	Total Surface of Coil and Former in Sq. Cm.	No. of Turns per Coil.	Size of Wire.	Insulation of Wire.	Resistance per Coil at 0° C.	Remarks.
I.	....	....	....	....	....	10.25 × 5.0	6.5 × 4.75	Thin presspahn adjacent to coil. Taped and varnished	Nil	960	2,270	21 S.W.G.	S.C.C.	30.050	....
II.	....	....	....	....	....	12.50 × 11.5	4.5 × 4.50	A covering of mica. Then taped and varnished	Nil	1,075	....	19 S.W.G.	D.C.C.	40.000	....
III.	....	....	....	....	....	....	5.0 × 2.50	Thick mica insulation round embedded portion. Taped	Nil	2,530	....	11 S.W.G.	D.C.C.	0.227	Stationary armature coil of alternator
IV.	Semi-enclosed motor.	10 B.H.P.	1,000	4	220	12.40 × 11.5	10.5 × 6.00	Varnished	Sheet iron	2,100	3,010	1.065 mm. diam.	D.C.C. 10 mils	33.310 33.420	Two similar machines, each of which was tested
V.	Protected type generator	7.5 k.w.	700	4	220	15.00 × 10.5	8.0 × 4.25	Varnished	Sheet zinc	1,815	....	....	....	29.850	Generator of a motor-driven booster set
VI.	Open type motor	36.5 H.P.	625	4	110	16.00 × 13.6	13.8 × 8.50	Partly bound with tape and string	Nil	3,400	655 445	No. 12 S.W.G. " 13 S.W.G.	S.C.C. 8 mils	3.000	Combined motor-generator set
VI*a*.	Open type generator	24.0 k.w.	625	4	150	16.00 × 13.6	13.8 × 8.50	"	Nil	3,400	600 900	" 13 S.W.G. " 14 S.W.G.	S.C.C. 8 mils	5.825	

on Coil Iγ and my own tests on Coil VI is interesting. The coils are of comparable size, and neither of them wound

3. Machine Running Light at Normal Speed—The ventilation caused by the rotating armature must vary considerably

end connections. In reference to the latter, the direction of rotation of the armature may also affect the ventilation.

TABLE II.

DETAILS OF THE COILS USED BY E. H. RAYNER, E. BROWN, AND NEU, LEVINE AND HAVILL.

No. of Coil.	Reference.	Type of Machine.	Capacity of Machine.	Normal Speed in Revs. per Min.	No. of Poles.	Excitation Voltage.	Covering of Coil.	Former	Estimated Total Surface of Coil and Former in Sq. Cm.	Remarks.
1*a*	E. H. Rayner, *Journal Inst. Elec. Eng.*, 1905, p. 613	Shunt motor	26.5 k.w.	850	4	440	Empire cloth and tape	Nil	2,620	....
1γ		" "	26.5 k.w.	850	4	440	" " " "	"	"	....
1δ		" "	26.5 k.w.	850	4	440	Nil	"	"	Berrited d.c.c. wire
2		" "	75.0 k.w.	305/550	6	550	Two layers tape	"	5,270	Coil impregnated
3		" "	75.0 k.w.	600	6	500	Varnished only	Sheet iron	4,020	....
4		Compound motor	82.5 k.w.	265/360	6	500	Three layers cambric Four layers boot webbing	Nil	3,320	Series winding all at one end of shunt coil
5		Shunt generator	147.0 k.w.	180	4	210	Varnished only	Brass	13,000	....
6		" "	200.0 k.w.	350	6	220	" "	Cast iron	11,320	....
8		" "	500.0 k.w.	320	8	490/600	Canvas, paper, leatheroid and string, totaling ¼ in.	Nil	11,700	....
9		" "	500.0 k.w.	200	10	200	Canvas, fuller board, millboard and string	Brass and sheet iron	12,400	....
A	E. Brown, *Journal I.E.E.*, 1901, p. 1159	Shunt motor	7.5 k.w.	1,250	2	135	Nil	Part wood	....	....
B	Neu, Levine and Havill, *Elec. World and Engineer*, 1901, p. 56	Shunt motors	1 B.H.P. 5 B.H.P.	....	2	....	....	....	....	....

The total surface of the coils used by Mr. Rayner was estimated from the drawings given in his paper.

on formers. The five degrees extra heating of Coil Iγ is probably due to the extra covering and to the fact that the motor

under different conditions. It certainly varies with the general design of the machine and with the peripheral speed of the

It seems, therefore, that the temperature rise of field coils when the machine is running can not readily be prede-

termined, unless based on experiments made on machines of similar design.

E. Brown's tests on a small two-pole horseshoe-magnet type machine (a few

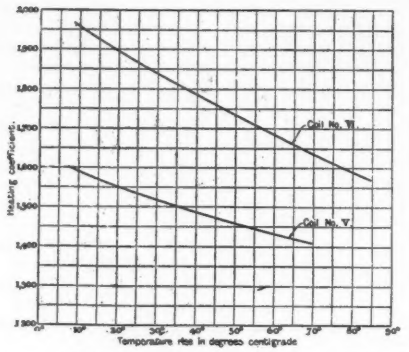


FIG. 5.—HEATING COEFFICIENT OF COILS IN POSITION, MACHINE STATIONARY.

	Total Surface.
Coil No. V. wound on zinc former..	1,815 sq. cm.
Coil No. VI. no former, very little covering	3,400 sq. cm.

particulars of which are given in Table II), show to some extent the variation of coil heating with speed. From his temperature-grade curves I have estimated the mean temperature rise of the coil, and have plotted these figures against the peripheral speed of the armature, as shown in Fig. 6. These curves show the kind of variation which may be expected in similar machines.

The two semi-enclosed ten-horse-power motors to which Coil IV belongs show very little advantage due to the revolving armature (see Fig. 7). This is probably due to the enclosed design, and to the proximity of the commutating poles with which these machines are provided. In connection with the tests on these two

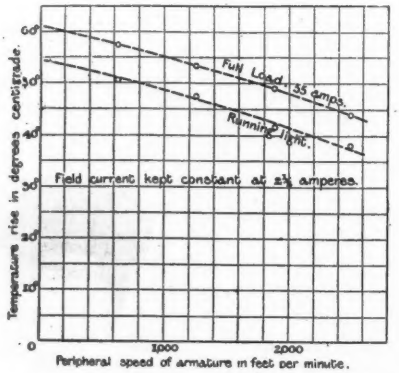

Full Load. 35 amps.
Running light.
Field current kept constant at 2½ amperes.
Temperature rise in degrees centigrade.
Peripheral speed of armature in feet per minute.

FIG. 6.—VARIATION OF TEMPERATURE RISE WITH SPEED, COIL A.

Two-pole machine with armature above magnets, tested by E. Brown.
See Table II.

machines it was noticed that when running the coils on one machine heated appreciably more than those on the other. The machines are of exactly similar design, and are mounted in line on a common foundation. A clutch is provided for coupling them together, half of which is keyed to each motor spindle. The commutator end is thus in each case outside.

Fig. 6 shows the increase of heating due to full load in the case of the machine tested by Brown to be about fifteen per cent at normal speed.

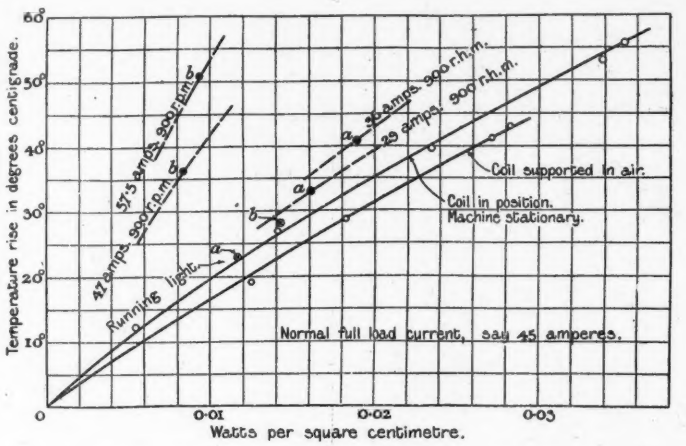

Temperature rise in degrees centigrade.
57·5 amps. 900 r.p.m.
47 amps. 900 r.p.m.
Running light.
35 amps. 900 r.p.m.
25 amps. 900 r.p.m.
Coil supported in air.
Coil in position. Machine stationary.
Normal full load current, say 45 amperes.
Watts per square centimetre.

FIG. 7.—VARIATION OF TEMPERATURE RISE OF COIL IV.

Two ten-brake-horse-power, 220-volt, semi-enclosed motors, 1,000 revolutions per minute, fitted with commutating poles.
For details of coil see Table I.
Motor A was run in the direction giving the better fanning action.
Motor B was run in the direction giving the worse fanning action.

The machines are wired so that they run in the same direction. The armatures consequently revolve in opposite directions with respect to the slope of the free portions of the armature winding, and it is noticeable that the machine (motor A) running against this slope works appreciably cooler than the other (motor B). The pressure of the air entering and leaving the machine was measured by means of a sensitive pressure gauge, and found to be appreciably greater in the case of machine A than with machine B.

4. Machine Running Fully Loaded—The heating of field coils when the machine is fully loaded depends to a large extent on the temperature rise of the armature, and also upon the efficiency of the ventilation under full-load conditions. The figures for the heating coefficient consequently vary considerably.

Fig. 7 shows the heating with various armature currents of the field coils of several ten-brake-horse-power semi-enclosed motors. The rapid increase with overload is probably due in a large measure to the close proximity of the series-wound commutating poles.

In Table III will be found the values of the heating coefficient for fully loaded machines of which data are available. In each instance the total surface is taken into account, and the figure is quoted for a final temperature rise of fifty degrees centigrade. The figures for the square centimetres per watt and the watts per square centimetre are also given.

TABLE III.

HEATING COEFFICIENTS OF FULLY LOADED MACHINES.

Type of Machine.	Output.	Voltage.	Speed.	Covering of Coil.	Former.	Reference to Tables I and II	Ch.	Sq. Cms. per Watt.	Watts per Sq. Cm.
Two-pole shunt motor, armature above magnets.....	7½ k.w.	135	1,250	Nil	Part wood	A	1,025	20.5	0.049
Four-pole semi-enclosed shunt motor.....	10 H.P.	220	1,000	Nil	Iron	IV	3,300	66.0	0.015
Six-pole shunt motor.....	75 k.w.	550	325	Two layers tape	Nil	2	1,190	23.8	0.042
Ditto	75 k.w.	500	600	Varnished	Sheet iron	3	1,220	24.4	0.041
Six-pole compound motor..	82.5 k.w.	220	350	Cambric and boot webbing	Nil	4	2,380	47.6	0.021
....	....	....	....	Above removed	....	..	1,870	37.4	0.027
Eight-pole shunt generator.....	500 k.w.	480/600	320	Canvas, paper, leatheroid, and string	Nil	8	1,565	31.3	0.032

The variation in these figures, and the consideration of the numerous and uncertain conditions introduced by the rotating armature, show that it is not possible at present to fix any very definite figures

for the heating coefficient of fully loaded machines.

Conclusion—The tests and figures here recorded confirm the following points:

(*a*) The maximum temperature rise of a magnet coil seldom exceeds 1.2 times its mean temperature.

(*b*) The effect of the covering of the coil on its temperature rise is very marked. Such coverings should be reduced to a minimum, as also should the insulation thickness to core or former.

(*c*) A large coil heats slightly more than a smaller one for the same watts per square centimetre.

(*d*) Berrited wire produces a considerable reduction in the temperature rise.

(*e*) The heat-removing property of the iron core differs very little from that of the surface of the coil exposed to air, and consequently it is best to consider the whole surface of the coil and former when dealing with the heating coefficient.

1. SUPPORTED IN AIR.

	C_h
Medium-size plain coils, taped	1,500
" " " " mica and tape	1,650
" " " " heavily covered	1,750 to 2,250
" " coil, wound in metal former uncovered	1,500
" " berrited double cotton-covered wire	1,150

2. IN PLACE ON MACHINE.

Medium-size plain coil	1,750
" " wound in metal formers which slip loosely over core	1,550

3. MACHINE FULLY LOADED.

Small two-pole machines, armature above magnets	1,000
Moderate-size protected motors	2,000
" " semi-enclosed motors	2,500
" " " " " with commutating poles	3,000
Open-type machines, fifty kilowatts	1,250
" " " 500 kilowatts	1,500

(*f*) The heating coefficient varies considerably with the final temperature rise.

(*g*) From the point of view of cooling, a slight advantage is obtained with a coil wound on a metal former.

(*h*) A great deal may be done to secure cool running by cultivating a draught by means of the armature end connections, and by running the machine in the direction giving the maximum fan action.

The accompanying values of the heating coefficient for a fifty-degree centigrade rise are based upon the whole surface of the coil.

The Faraday Society.

The twenty-fourth ordinary meeting of the Faraday Society was held in London on Tuesday, December 11, 1906.

Dr. A. C. C. Cumming read a paper entitled "Contributions to the Study of Strong Electrolytes."

1. The Elimination of Potential Due to Liquid Contact—Certain solutions have the property of reducing the potential due to the contact of two solutions, and potassium chloride has been used for this purpose. In most cases a saturated solution of potassium chloride does not remove all the diffusion potential; indeed, if the solutions in the cells be strong, it only removes a small part. This property of removing more or less of the diffusion potential depends on two factors in the connecting solution; firstly, the positive and negative ions must be of equal velocity; and secondly, the concentration of the connecting solution must be high compared with the solution in the cells.

The author suggests a saturated ammonium nitrate solution as that which fulfils these two conditions better than anything else at present known, and shows by experiments with different cells that this is the case.

A curious point was noticed when two cells containing the same solution, but at different concentrations, were joined by a third solution of the same substance. Whatever the strength of this third solution, the observed potential remained the same as when the two cells were directly connected with one another. This has not been recorded before, but could have been predicted from Nernst's theory.

2. The Potentials of Silver Nitrate Solutions—The electromotive force between silver nitrate solutions of various strengths from $\frac{N}{1,000}$ up to $\frac{N}{2}$ was measured as accurately as possible. Three kinds of silver electrodes were used, and various methods were tried to eliminate the small amount of diffusion potential.

The results prove that for silver nitrate the electromotive force gives the same measure of the ionic concentrations as is obtained from the conductivities, and therefore support the view that the conductivity gives a true measure of the ionic concentration.

A paper on "The Electrochemistry of Lead" was read in abstract by Dr. Cumming.

The tendency of any ion (*i*) to be transformed into an ion (*o*) with a lower valence may be measured by means of an oxidation electrode. If *n* be the difference in valence of the two forms, the electromotive force in volts:

$$= P + \frac{0.0591}{n} \log_{10} \frac{C_i}{C_o} \text{ (at 25°)},$$

where the symbols have their usual meanings.

Some experiments were carried out to find how the addition of nitric acid affected the ionization of lead (plumbous) nitrate. The solubility of lead nitrate was shown to decrease very rapidly with increase of the nitric acid concentration.

Measurement of the plumbous ion concentration in alkaline nitrates showed that this varied greatly in different solutions, and the results proved that there was considerable complex formation between KNO_3 and $Pb(NO_3)_2$, but not so between $NaNO_3$ and $Pb(NO_3)_2$.

The results in general prove that lead in the tetrad form is a highly electropositive element, and also direct attention to a curious difference in the behavior of sodium and potassium nitrates towards lead nitrate.

A paper by R. W. Vicarey on "Storage Batteries and their Electrolytes" was read in abstract. The paper is a continuation of one read by the author in July, 1905, and deals chiefly with some of the problems involved in the manufacture of accumulators, particularly as regards the effect of nitrogen and other impurities introduced consciously or by accident in the process of manufacture. Nitrogen compounds are often used, and advisedly so in the opinion of the author, for assisting in the oxidation of the positive plates, and in such cases it is essential that every trace of nitrogen be removed before the cells leave the works, in spite of the difficulties, which are insisted upon, involved in its complete elimination. The evils attributed to nitrogen, both after complete formation and in the latter stages of the forming processes, are described in detail. Among other troubles, the author has observed the formation of an irreducible and unoxidizable sulphate of lead ($2PbSO_4.PbO$). The evil effects of nitrogen are greatly accentuated by the presence of other impurities—notably iron, an element likewise very difficult to eliminate—and experiments are described illustrating these effects, which become more serious with decreasing current densities. Researches of Peters, Elbs and Bell are quoted in support of the author's main contentions.

Some Data on the Simplon Tunnel Equipment.

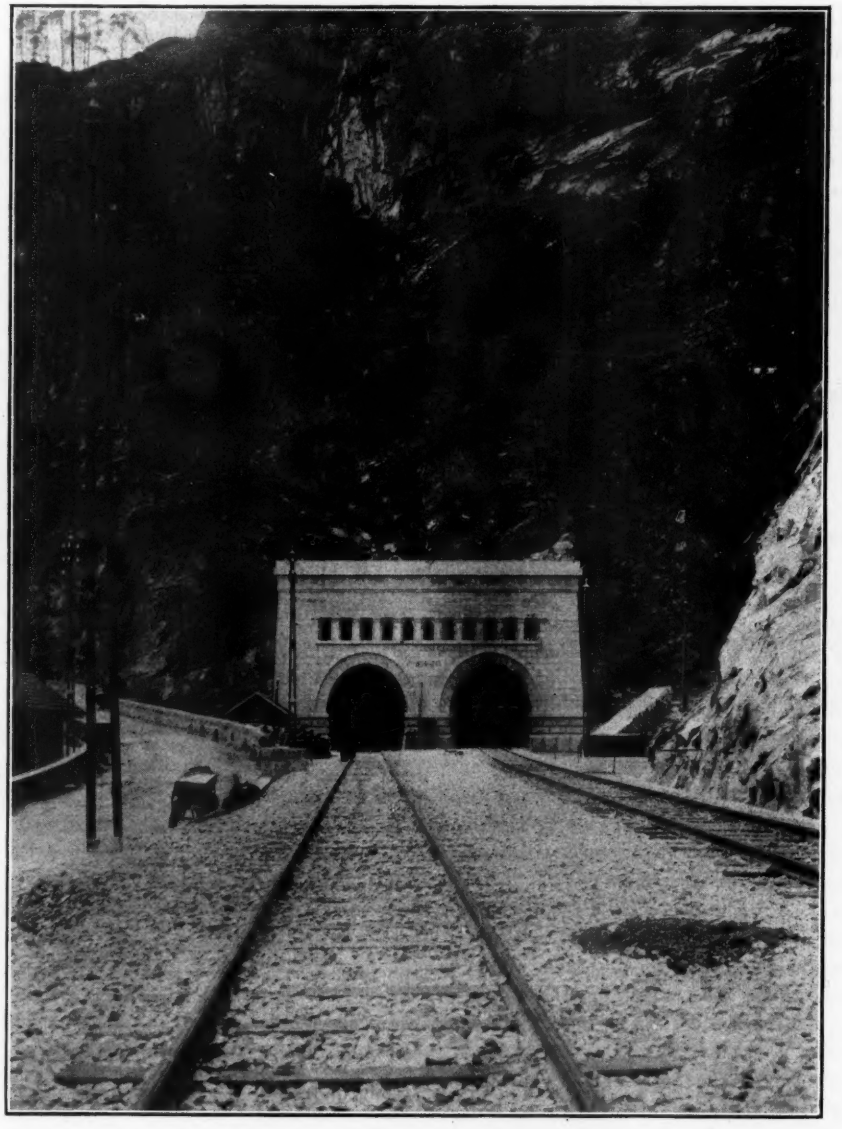
By B. F. Hirschauer.

ELECTRIC trains have been running in the Simplon Tunnel since the first of August, and at present the traffic through the tunnel is nearly all taken by the new electric locomotives. It will be remembered that the electric section is laid out from Brigue, on the Swiss side, which is a station on the steam railroad, to Domo D'Isola, on the Italian side, also a railroad station, and the Simplon section serves to connect the railroad system of the two countries, being a standard gauge track and using the regular railroad material. The electric locomotives which are used on the Simplon line have already been fully described in a preceding issue. We need only recall the fact that the locomotives, equipped, like the rest of the line, with material of Brown, Boveri & Company's make, have a total weight of sixty-eight tons and are driven by two three-phase motors of 450 horse-power each, with one motor placed on each axle. With a normal rating of 900 horse-power, the locomotive can be run as high as 2,300 horse-power on a maximum. It has two regular speeds of twenty and forty miles an hour, according to the motor coupling. The standard trolley line voltage is 3,000 volts, which is used directly upon the motors. At present we may give a short description of the wiring within the tunnel, and also of the two hydraulic plants which have been erected at the ends of the line in order to supply the current.

Inside the tunnel the trolley wire and the supporting parts had to be carefully installed, seeing that there is considerable moisture on the walls of the tunnel, which has the effect of rusting the metal as well as breaking down the insulation. It was decided to suspend the two double trolley wires from a short cross-wire which runs across near the roof of the tunnel, being stretched between two bracket hooks, but separated from the latter at each side by a spherical insulator. The cross-wire is of steel, but it is copper-covered, as the steel would be soon attacked, and the wall brackets are of a bronze alloy for the same reason. On the roof of the locomotive is carried a trolley frame containing two horizontal bars which run against each pair of wires to take the current. Inside the tunnel the trolley wires are placed at a height of sixteen feet above the level of the rails and lie at a distance of forty inches apart. Outside the tunnel the electric line runs for a certain distance to the stations of Brigue and Domo D'Isola. On these sections the trolley wire is held by a suitable support which varies in different places. Where there are a number of tracks in the station yards, it is found convenient to use a horizontal iron pipe running across all the tracks and upheld by supports formed of two or three pipes joined at the top and spread out at the base. The trolley wire is suspended from a steel cross-wire which runs between the vertical supports just below the horizontal piping. This arrangement is simple and has been found to answer very well. It is to be remarked that the trolley wire is not run in a straight line, but is made to take an undulating path so as to come over all the length of the trolley bar, thus giving it an even wear.

Care has been taken in designing the suspension piece for the trolley wire. It has a set of springs so as to give it an elastic suspension, and at the same time the insulation has been well carried out so as to give no trouble when working upon 3,000 volts. Outside the tunnel the trolley wire lies at about seventeen feet above the rail level.

The two hydraulic plants are arranged so as to supply circuits for the lighting



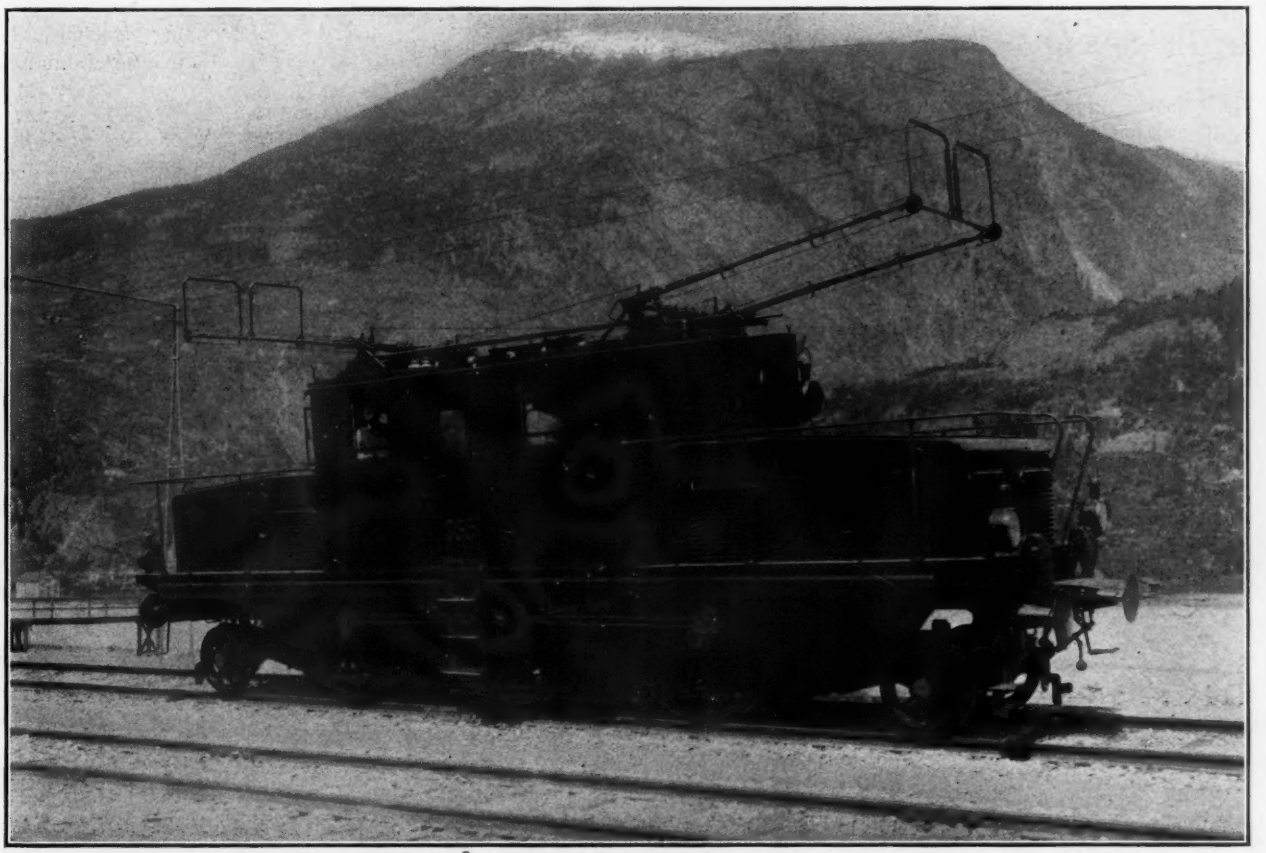
THE PORTAL OF THE SIMPLON TUNNEL ON THE ITALIAN SIDE, SHOWING METHOD OF SUPPORTING TROLLEY WIRES.

of each of the terminal stations and yards, the section of the trolley line outside the tunnel at either end, and the section lying inside the tunnel, and these circuits are so laid out that by the proper switching either of the two electric plants can be connected with them, or again the two plants can be connected with their machines running in parallel upon the circuits, and the latter are divided into five sections, with a switch point between each of them. The three-phase alternators have two poles connected to each of the two overhead trolley wires respectively, while the third pole goes to earth. One side of the motor on the locomotive is likewise connected to earth by means of the track rails.

Within the tunnel the feeder wires consist of concentric cables each having 100 square millimetres section. The cables are supported along the roof of the tunnel and are protected by a covering of angle-iron. Outside the tunnel the feeders are run upon poles and consist of a single copper wire of nine millimetres gauge. A well-arranged telephone system is installed in the tunnel, where there are a number of posts, and these are connected with a central station which is also joined to each of the terminal depots. One very useful device is used to keep a check upon the running of the trains. It consists of an automatic clockwork registering system, and is composed of a series of contact pieces placed along the track at stated intervals. These contacts are connected to corresponding electromagnetic recording devices in a main apparatus, and each magnet makes a point upon a strip of paper driven by clockwork like a Morse receiver. As the train passes each contact point, the corresponding mark is made on the paper strip, so that when the driving speed of the latter is known it is easy to see the speed of the train as it passes along the track. At the same time the exact time of the passage of the train at any given point is known.

The new hydraulic station which has been erected at the Swiss end of the line, at Brigue, has been equipped with two Escher-Wyss turbines and an alternator of the Brown, Boveri & Company's make. The Brigue plant operates upon a 146-foot head of water, and at present it has a total capacity of 1,200 horse-power. In the plant are erected two principal turbines rated at 600 horse-power each. Both wheels run on the shaft of the alternators. These machines have a twelve-pole internal field and an exterior armature. The armature is of the slotted type and in each slot are laid four square-section copper bars, insulated with mica from the armature iron. A good air current is given by the holes in the outer casting. The machine is designed to operate at 3,000 volts at the terminals and fifteen cycles. Owing to the conditions which prevail here, it is desired to keep the load always at a constant value upon the alternator, and in order to do this the company makes use of a liquid resistance which can be varied so as to take up the proper amount of load. Of a simple form, it consists of a tank having a constant water circulation and containing a set of iron plates. A hand device allows of raising or lowering them to the right amount in the water.

The switchboard in the Brigue plant is of the marble panel type and is mounted in an iron framework standing out from the wall. The Brigue plant also contains a direct-current generator, furnished at the beginning of the work on the tunnel



VIEW SHOWING ELECTRIC LOCOMOTIVE USED IN THE SIMPLON TUNNEL AND THE CURRENT COLLECTORS, WITH THE METHOD OF TROLLEY WIRE SUSPENSION.

by the Oerlikon firm, and it was then employed for lighting the different parts of the work. At present it serves to give the exciting current for the alternator, and works on 125 volts and 500 amperes.

The second hydroelectric station which has been erected at Domo D'Isola is equipped with an entirely new outfit, using Piccard and Pictet turbines, built at Geneva. It has a total capacity of 3,000 horse-power. The two turbines are mounted upon the same shaft and the alternator is placed between them, the running speed being 960 revolutions per minute as the standard. In both these plants the alternators deliver the standard voltage of 3,000 volts at fifteen cycles directly to the feeders which leave the station.

Electric Gold Dredge at Ruby, Mont.

The Conrey Placer Mining Company at Ruby, Mont., has had in operation two large steam-operated gold dredges. A third dredge has been added to this equipment which is driven electrically. This is of the single-shift, sluice-box type. The hull is 130 feet long by forty-eight feet wide. The ladder is 100 feet from centre to centre. It is of bridge-work construction and supports the chain system of forty-one buckets and forty-one links. Each bucket weighs 2,600 pounds, and the links weigh 1,400 pounds. In operation the dredge is swung from side to side by means of three-quarter-inch cables connected to a winch driven by a ten-horse-power variable-speed induction motor. The dredge is held to its work by a mooring-line system controlled from a large winch driven by a thirty-horse-power variable-speed induction motor. The power for digging is transmitted through a specially built 150-horse-power motor of the same type, capable of an overload of 100 per cent and able to stand a stall for three minutes. The latter is suspended by means of two cables connected to a hoist propelled by a seventy-five-horse-power variable-speed induction motor. For washing the matter brought up there are a ten-inch volute pump coupled to a fifty-horse-power motor; a twelve-inch centrifugal pump coupled to another fifty-horse-power motor, and a fourteen-inch horizontal volute pump coupled to a seventy-five-horse-power motor. The total capacity is 12,500 gallons per minute. The current employed is alternating sixty-cycle three-phase, transmitted from the Madison River plant, about thirty-five miles away. at a voltage of 46,000. It is stepped down to 2,200 for use aboard the dredge. There are several smaller motors for which it is stepped down again to 400 volts. The controllers of the various motors, as well as the operating levers for the brakes, etc., are mounted in the pilot-house. The dredge has a capacity of about 100,000 cubic yards per month when operated continually.—*Journal of Electricity, Power and Gas (San Francisco), December 29.*

PRACTICAL TESTING OF INDUCTION MOTORS.

BY R. E. HELLMUND.

In testing induction motors the use of the circle diagram has proved for many years of considerable help to the engineer. It has also been generally recognized that it is in almost all practical cases sufficient to use instead of a complicated theoretically exact diagram, a simplified diagram as, for instance, the one described by A. Heyland in his little book "The Graphical Treatment of Induction Motors," or the diagram derived by A. S. McAllister.[1]

In spite of this the results derived from the diagram, which as a rule is plotted from the no-load test and the blocked-rotor tests, differ in a great many cases from the true performance of the motor by amounts which are greater than desirable in practice.

In the following some of the phenomena causing said inexactnesses will be discussed.

It is well known that in deriving the theory and the diagram of the induction motor the leakage coefficient is a factor of the highest importance and that the size of this factor determines more than anything else the performance of the motor in every respect. The total leakage coefficient stands in a well-known relation to the primary and secondary coefficients. The primary leakage coefficient is the ratio of the flux which threads the primary winding of the motor without threading the secondary windings, to the total primary flux while no secondary reaction by load currents takes place. The secondary leakage coefficient is the ratio of the flux which threadens the secondary winding of the motor without threading the primary windings, to the total secondary flux while no reaction from the primary winding by load currents takes place. It is obvious that these two ratios and, therefore, the value of the total leakage coefficient, depend largely upon the reluctance of the various magnetic paths, and it is customary to assume that all magnetic reluctances are constant for all load conditions. How much this assumption is in accordance with the facts may be discussed in some practical cases by comparing the no-load, the full-load and the blocked-rotor conditions.

The reluctance of the total flux of the stator may be considered first. In a well-designed motor for higher frequencies the reluctance of the total primary flux in the iron parts is only a very small percentage of the reluctance of the air-gap; therefore, a change in the value of the total primary flux does not change the reluctance of its path very much in this case. Curve "A" in Fig. 1 gives the magnetizing current of a motor for sixty cycles and curve "B" shows the reluctance of the total primary flux derived therefrom. The total variation of the reluctance is only about five per cent. The total primary flux in this motor is in a certain unit

At no load	0.127
At full load	0.122
At blocked rotor	0.060

and the corresponding reluctances taken from curve "B" are in a certain unit

At no load	2.28
At full load	2.27
At blocked rotor	2.40

The differences between these values do not affect the leakage coefficient by more than five per cent of its value and, therefore, they may be neglected in practice.

The growing competition has caused, however, several manufacturers to build induction motors with very high densities in the iron, and, therefore, the conditions are not always as favorable as in the above case; especially in motors for low frequencies the reluctance of the total primary path changes in many cases considerably with the load condition. Curve "A" (Fig. 2) shows magnetizing current of a twenty-five-cycle motor, and curve "B" gives the reluctances of the total primary flux derived therefrom. The total primary flux in this motor is in a certain unit

At no load	0.140
At full load	0.133
At blocked rotor	0.085

and the corresponding reluctances taken from curve "B" are in a certain unit

At no load	2.90
At full load	2.61
At blocked rotor	1.88

Therefore, we have the following differences in per cent of the reluctance at no load:

Between no load and full load	10 per cent
Between full load and blocked rotor	25 per cent
Between no load and blocked rotor	35 per cent

It is obvious that these differences cause variations in the value of the leakage coefficient which are not at all negligible in practice.

In order to study the reluctance of the leakage path, the various kinds of leakage must be considered separately.

The end-connection leakage flux goes around the end connections of the wind-

[1] *Electrical World*, May 26, 1906.

ing almost entirely through air; its reluctance will, therefore, as a rule be constant.

The slot leakage flux goes together with the main flux through the iron core, through the teeth near the pole limits, then through the thin tooth tips and across the slot openings.

The zig-zag leakage flux goes also, together with the main flux, through the iron core, through the teeth near the pole limits, then partly directly through the air-gap to the other member and partly through the tooth tips and the air-gap to the other member.

reluctance flux by an amount of practical importance. The reluctance across the slot and across the air-gap is constant, and it remains to consider the reluctance of the tooth tips and the teeth. At no load the leakage flux going through the tips is hardly ever more than three per cent of the total motor flux and therefore, the tips will be hardly saturated. Since, however, the leakage flux increases with the currents in the motor, the flux going through the tooth tips may be for the full-load condition already ten to fifteen per cent of the total motor flux, and it is obvious that the tips will then,

In order to determine how much the leakage reluctance varies with the size of the leakage field in practice a motor with very low ohmic resistance in both members has been tested. In such a motor with blocked rotor almost the total field existing is leakage field and the ratio of the primary current to the impressed electromotive force is a very close measure for the reluctance of the leakage path. In Fig. 3 the curve A gives the primary current and curve B the reluctance of the leakage path derived therefrom. From these curves the reluctance for each primary current may be found.

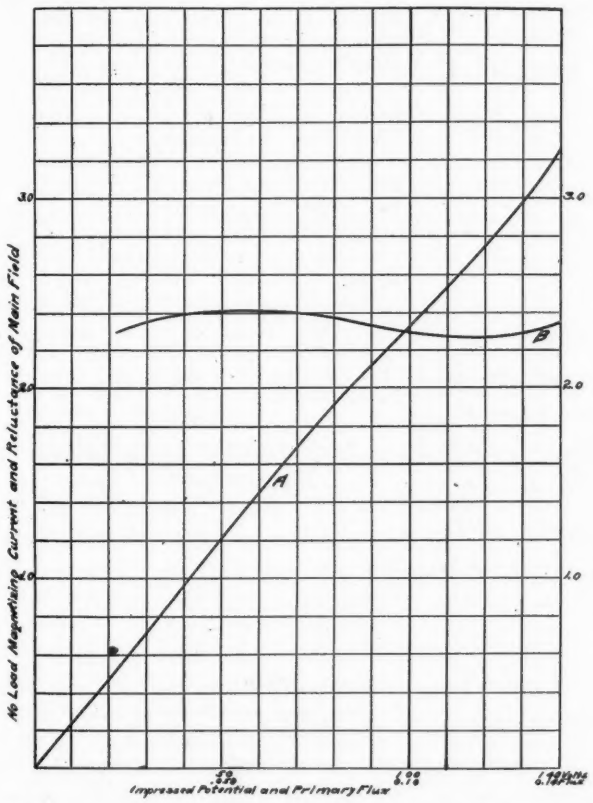


FIG. 1.—SHOWING A SLIGHT CHANGE IN PRIMARY RELUCTANCE (CURVE B) WITH CHANGES IN MAGNETIZING CURRENT (CURVE A).

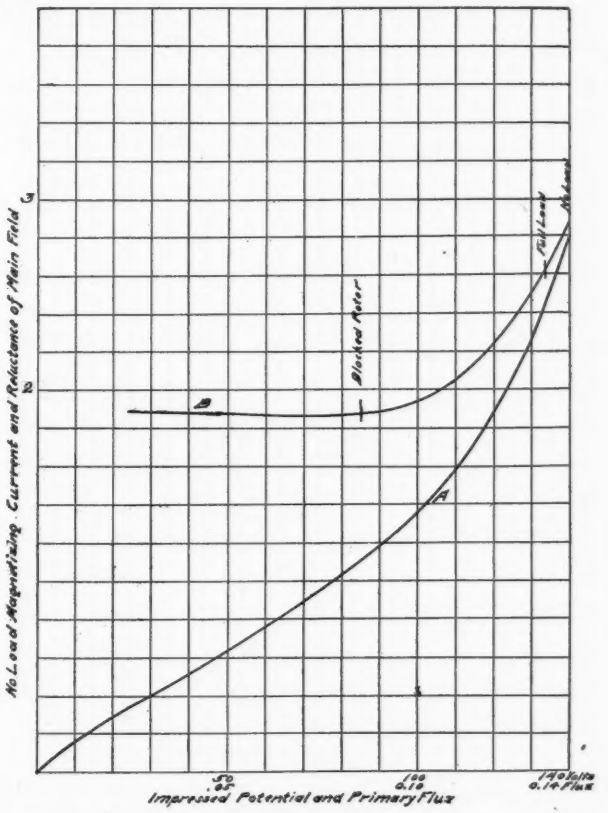


FIG. 2.—SHOWING LARGE CHANGE IN PRIMARY RELUCTANCE (CURVE B) WITH CHANGES IN MAGNETIZING CURRENT (CURVE A) WHEN HIGH MAGNETIC DENSITY IS USED.

We know that even in a highly saturated motor the reluctance of the iron core is hardly ever more than fifty per cent of the total reluctance of the main flux. We also know that the total reluctance of the slot and zig-zag leakage fluxes is in all practical cases at least ten to twenty times as high as that of the main flux. Therefore, we know that the reluctance of the core as part of the slot and zig-zag leakage reluctance is hardly ever more than $\frac{50}{10}$ to $\frac{50}{20} = 5$ to $2\frac{1}{2}$ per cent of the total slot and zig-zag leakage reluctance. It is obvious from this that any variation of the reluctance of the core will not change the total slot and zig-zag leakage as a rule, be pretty well saturated. With blocked rotor the flux going through the pole tips may amount to from thirty per cent to forty per cent of the value of the total motor flux at no load, and it is obvious that then the tooth tips will be highly saturated, and a considerable increase of the slot and zig-zag leakage reluctance may be effected thereby. Also the reluctance of the teeth near the pole limits, through which a leakage flux of a size up to fifty per cent of the value of the total flux of the motor at no-load may pass, when the rotor is blocked, may be for this condition much larger than it is for the no-load and full-load condition.

In the case under consideration the current of the motor was

4.8 amperes at no load,
12.7 amperes at full load,
70 amperes at blocked rotor,

and the corresponding reluctances are in a certain unit for

No load	**105**
Full load	**107**
Blocked rotor	**140**

It will be seen that while the difference between the no-load and full-load condition is not very great, there is a difference of about twenty-five per cent between the no-load and the blocked-rotor condition. Similar results were obtained from tests on other motors of normal design.

It has been shown that the reluctance

of the total motor flux as well as that of the leakage flux change considerably with the load condition. Unfortunately, the changes are both in such a direction that they add themselves; it will be remembered that the total flux of the motor decreases, while the leakage flux increases with the primary current. Both changes tend, therefore, to decrease the leakage coefficient while the stator current increases, and according to the above tests it is possible that the change of the leakage coefficient from no-load to the blocked-rotor position may amount to as much as fifty per cent, and it is a fact that it amounts in most motors on the market to at least fifteen to twenty per cent.

It follows from these facts that it can not be expected that the same circle diagram will give results for all-load conditions equally well. It is, however, possible to obtain from the no-load and blocked-rotor test a diagram which is exact for one condition, for instance, for full load. The right full-load condition for the reluctance of the total or main field of the motor may be pretty exactly obtained by making the no-load test with a potential which is as many per cent lower than the normal impressed potential as the primary ohmic drop in per cent calls for. In most cases the primary ohmic drop for full-load is approximately known; it is between two and seven per cent for almost all motors between 100 and one horse-power. A little inexactness in the assumption of this value is of little influence. The magnetizing current found for this lower potential may be i_m then the values which are used for plotting the diagram should be

$$I_m = i_m \frac{e_n}{e_t}$$

Where e_n is normal potential and e_t the potential which has been applied for the test.

The right full-load condition of the reluctance of the leakage field may be almost exactly obtained by making the blocked-rotor test with such a potential *that about full-load current is flowing in the stator.* The value of the current which is used for plotting the diagram should be $I_b = i_b \frac{e_n}{e_t}$

where i_b is the tested current with blocked rotor,

where e_t is the tested potential with blocked rotor,

where e_n is the normal motor potential.

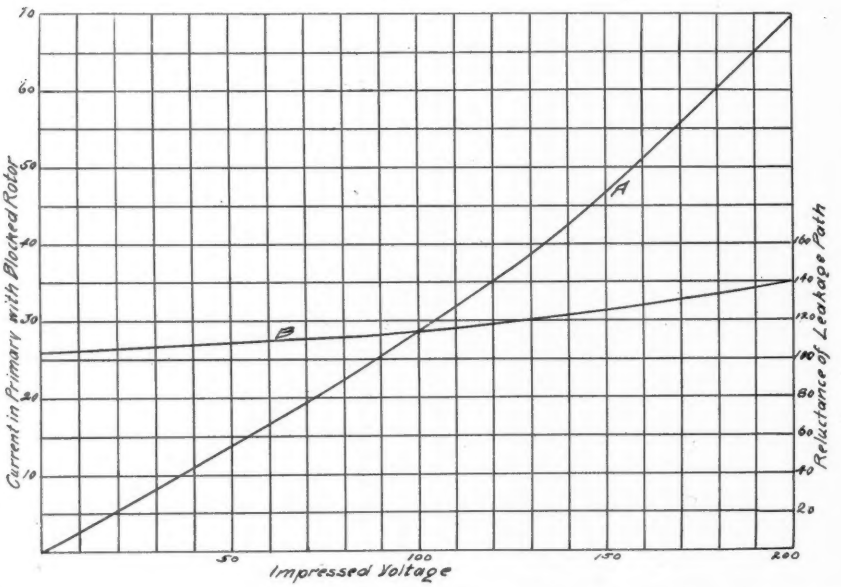


FIG. 3.—SHOWING VARIATION IN RELUCTANCE OF LEAKAGE PATH (CURVE B) WITH CHANGES IN PRIMARY MAGNETIZING CURRENT (CURVE A.)

The power-factor of the current for blocked rotor is found directly from the test values. As stated before, a diagram plotted with these values will be practically exact for full-load conditions.

Since we have seen the reluctances between full-load and no-load condition as a rule do not change more than a few per cent, the diagram will in most cases also be fairly exact for all-load conditions between no load and full load. It will be also fairly exact for the customary overloads of twenty-five and fifty per cent. It must not be expected, however, that this same diagram gives very close results outside of this range. Special tests as outlined before will be necessary if other loads shall be determined with any degree of exactness. Mostly it is, however, sufficient to know the performance from no load to 150 per cent full load and the starting condition. The latter may be easily determined by a few tests with the potential being used for starting the motor. It is not advisable to use any other potential for the starting tests, because on account of the varying reluctances it is not correct to make the customary assumption that the starting torque increases proportionally to the square of the impressed potential. In most cases the starting torque increases considerably quicker than the square of the impressed potential.

It is hardly necessary to call attention to the fact that the leakage coefficient also changes with the position of the rotor. Therefore, in determining the data for the running motor conditions, the blocked-rotor tests should be made for various rotor positions and average values from the various positions should be determined for plotting the diagram.

The above outline of tests, of course, should be also followed up if tests for determining the leakage coefficient by any other than the graphical method are made. For instance, if the leakage coefficient shall be found from the formula given by the writer on page 523 of ELECTRICAL REVIEW, April 7, 1906.

I have to thank P. S. More for the care he took in making the tests cited in the above.

Merchants' Association Passenger Rates.

The Merchants' Association of New York announces that merchants' rates from the Central West, which is designated by the railroads as Central Passenger Association Territory, will be in effect to New York city on February 9-13, inclusive, and March 2-5, inclusive, with a thirty-day return limit. The special rate is a fare and one-third for the round trip, the reduction being granted under the certificate plan.

The railroads members of the Central Passenger Association traverse the following section:

Points west of (but not including) Buffalo, Niagara Falls, Suspension Bridge and Salamanca, N. Y., Pittsburg and Allegheny, Pa., Bellaire, Ohio, Wheeling, Charleston and Huntington, W. Va., and points on and north of the Ohio river and east of the Mississippi river, and south of a line from Keokuk, Iowa, to Chicago, Ill., including Cincinnati, Louisville, all towns in Kentucky on the Chesapeake & Ohio Railway, Cairo, St. Louis, Keokuk, Chicago, the Southern Peninsular of Michigan, and Canadian towns on the Michigan Central Railroad and Wabash Railroad.

Efforts are now being made by the Merchants' Association of New York to arrange merchants' rates to the metropolis from the southwest.

The Helion Filament Incandescent Lamp.

During the recent meeting of the American Physical Society, held in conjunction with the American Association for the Advancement of Science, in New York city, a paper was read by Professor H. C. Parker, of Columbia University, and Walter G. Clark, of the Clark Electric Manufacturing Company, New York city, which described a new incandescent lamp and showed its peculiar properties. This lamp is the result of a number of years' work, part of which has been carried out at the Phoenix Physical Laboratories of Columbia University.

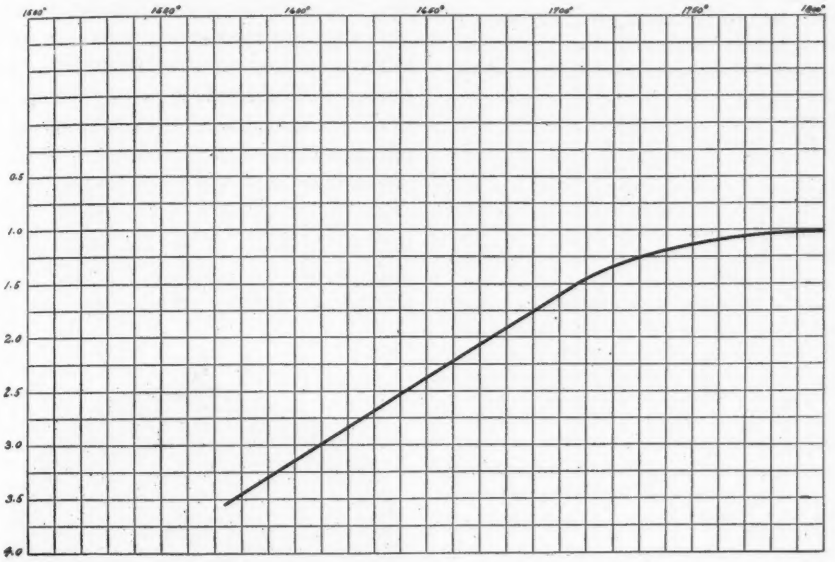


FIG. 1.—CURVE SHOWING THE POWER CONSUMPTION IN WATTS PER CANDLE, OF A HELION LAMP AT DIFFERENT TEMPERATURES.

The name "Helion" has been selected because the spectrum of the light given by the new lamp is notably white, resembling the light of the sun, the Greek name for which was "helios." The features of the new filament are the method of manufacture, the high efficiency and the peculiar physical characteristics. The filament is formed by depositing on a carbon filament, as a base, various materials, among which is silicon, which are introduced into the treating chamber as vapors. This process resembles the flashing process as employed in preparing ordinary carbon filaments. The constituents of the vapor are deposited on the surface of the carbon base and seem to penetrate deeply into it. The treatment is carried out in a special chamber, and after it is completed the filaments are removed and mounted in ordinary glass bulbs. This method is necessary because the current passing through the filaments during the treatment would fuse the platinum leading-in wires, and, also, the action of the vapors would affect the cement. The latest work in this direction has produced strong, elastic filaments which can be drawn out straight, even though they normally have a double loop, and which, upon release, resume exactly their first shape.

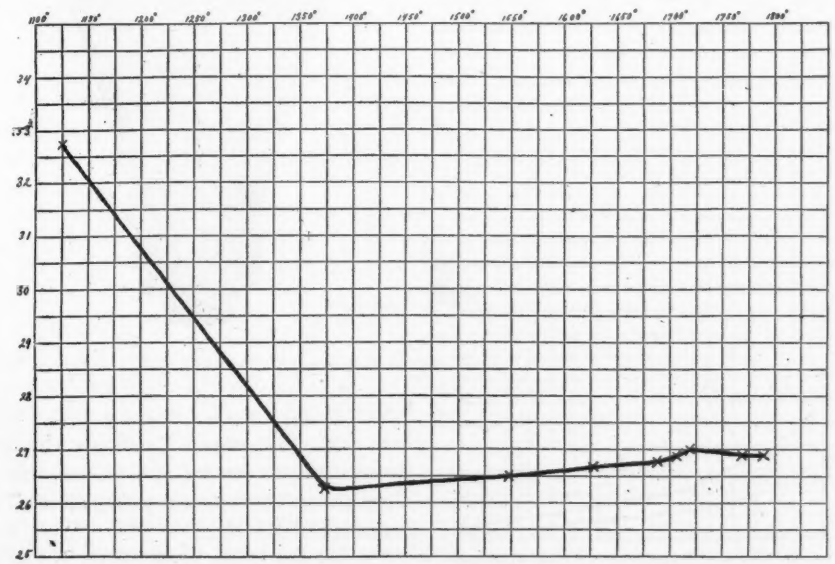


FIG. 2.—THE RESISTANCE, IN OHMS, OF A HELION FILAMENT AT DIFFERENT TEMPERATURES.

The results obtained by this treatment depend upon the conditions maintained. The longer the treatment, the greater is the percentage of silicon deposited on the carbon; and it would seem from tests which have been made that the smaller the percentage of carbon the higher the efficiency at which the lamp may be operated. Tests have been made in which the percentage of the coating varied from ten to seventy, which gave these results.

A noteworthy feature of this filament is that it operates at an efficiency of one watt per candle, but this rating is not fixed, as better efficiencies—in one case about three-quarters of a watt per candle—were obtained by longer treatment. What the ultimate rating will be can not be said as yet. At present the inventors are satisfied to designate it as one watt per candle.

With this efficiency the question of useful life becomes important. No final figures can be given for this, because the greater part of the efforts of the inventors have been in the direction of determining the best method of treatment for producing reliable results. Lamps have, however, been made which have run for over 1,200 hours. In one case the lamp ran for 1,270 hours, starting at thirty-seven watts and thirty-seven candles. As the test progressed the candle-power increased to forty and then again fell to thirty-seven, the consumption of power remaining constant. Lamps have been made which have run for 400, 600 and 800 hours, but no life tests have been made on more recent samples, as the time has not yet sufficed.

The physical characteristics of the new filament are remarkable. The efficiency of the lamp increases with an increase in temperature, and it is notable that the lamp begins to glow and gives a white light when a corresponding carbon filament would still be black or showing only a faint red glow. As the temperature is increased the intensity of the light increases, as does also the efficiency. In Fig. 1 is shown a curve giving the relation between the watts per candle and the temperature of the filament measured by means of a Fery pyrometer. In this

instance the efficiency increased until it reached nearly one watt per candle at 1,800 degrees (black body temperature). It was found that if the temperature be carried still higher that the efficiency per candle decreased; in fact, the candle-

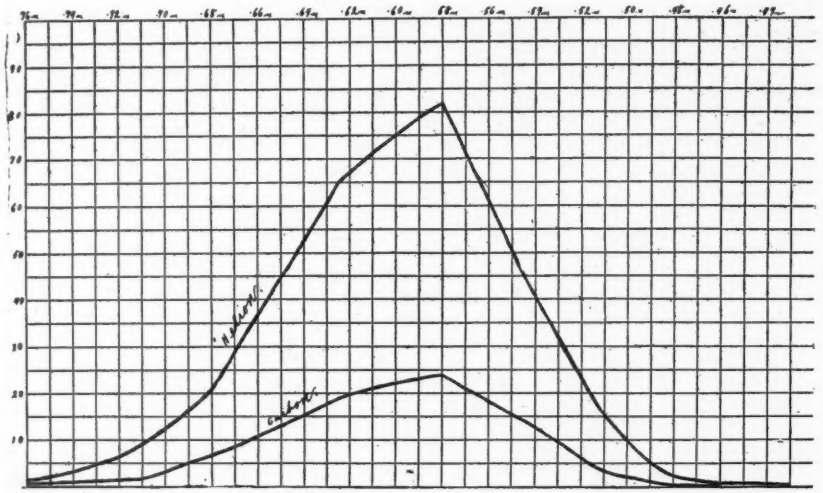


FIG. 3.—CURVES SHOWING RELATIVE LUMINOSITY OF A HELION AND A CARBON LAMP THROUGHOUT THE SPECTRUM.

power of the lamp seemed to be independent of the temperature at higher points. The temperature-resistance coefficient is shown in Fig. 2, which is the result of tests on two lamps, the readings of which agree closely. It will be noted that this coefficient is negative in this instance from 1,125 degrees up to 1,350. From this point it becomes positive and increases slowly up to about 1,720 degrees, at which

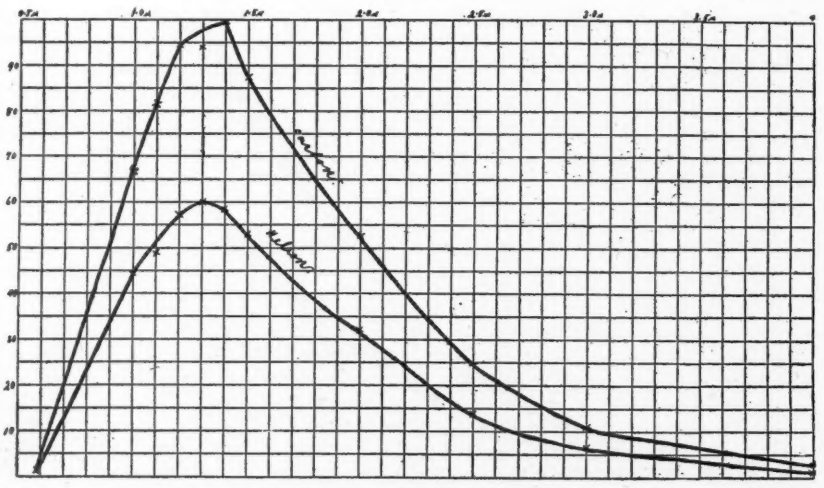


FIG. 4.—CURVES SHOWING THE RELATIVE AMOUNTS OF ENERGY RADIATED BY THE HELION AND CARBON LAMPS GIVING THE CURVES OF FIG. 3.

point there is a kink in the curve, and beyond this there is a slight decrease. On account of this kink it was decided that the proper temperature for that particular lamp would be a little under 1,720 degrees, so as to take advantage of the slight inherent regulation of the filament at that temperature. Two or three times the normal current may be passed through these filaments without destroying them. In one case a short piece of filament was mounted on copper leads in a bulb, and current was then passed through until one of the copper wires was fused. The filament showed no effect of the treatment; in fact, it is said that none of these filaments has been burned out: their destruction has always taken place by breakage, which occurs generally near to the leading-in wires or at the anchor, and is thought to be due to the strain set up at that point by the vibration of the filament and the anchor. A new method of anchoring has been devised by Mr. Clark, which, it is believed, will avoid this strain. In mounting the filaments in the bulbs it is very necessary to set them up in exactly the shape which they normally take, in order to avoid this strain.

The metallic nature of the surface of the filaments has been demonstrated by the fact that after breaking they may weld together if brought into contact.

The character of the spectrum is shown in Figs. 3 and 4. Fig. 3 shows two curves, one being for a Helion incandescent, and one for an ordinary carbon filament; while Fig. 4 gives corresponding curves for the relative energies of the Helion and incandescent filaments. It would seem from this that although the Helion filament was taking considerably less energy than the carbon filament, it was giving several times more light. These curves seem to show that the efficiency of the Helion filament is due to selective radiation, a greater proportion of its energy being given out as

FIG. 5.—HELION LAMP FOR 115 VOLTS.

luminous rays when compared with carbon; and this proportion holds closely throughout the entire visible spectrum. Upon this phenomenon depends the white character of the light.

The general form of the lamp is indicated by Fig. 5, a photograph of a certain test lamp. It is seen that it resembles closely the ordinary carbon filament lamp; in fact, the only apparent difference between the two is the intensity and whiteness of the light given by the Helion filament.

During certain tests of these lamps it

was observed that when an irregular deposit was produced by some accident or purposely that these enlarged portions of the filament showed apparently the same intrinsic brilliancy as the thinner portions; in fact, projecting spurs have been purposely produced, which, under normal running, glowed brightly out to the extreme tip. It was further observed that an increase in the efficiency of the lamp could be secured by carrying it to a temperature higher than that at which it is intended to run. Carrying the filament over 1,800 degrees seems to produce a sort of tempering which gives the lamp a set. Variations in temperature after this produce no further effect. Although no particular effort has been made to produce small units, it is thought that there will be no difficulty in making thirty-candle-power, 110-volt lamps. Probably lamps of considerably less candle-power can be made. As mentioned above, conclusive figures for the life of the lamp are not yet available. These experimental lamps have been exhausted at the laboratory, where the facilities for this purpose are not of the best. It is thought that better results will be obtained when improved methods of exhaustion which have been devised by Mr. Clark are put into operation.

Exhibit of Electrical Appliances at the Seventh Annual Automobile Show.

A number of interesting exhibits of electrical appliances were made at the seventh national automobile show of the Association of Licensed Automobile Manufacturers, which was held at Madison Square Garden, New York city, January 12 to 19.

The Atwater Kent Manufacturing Works, Philadelphia, Pa., showed a number of Atwater Kent spark generators for ignition purposes. This sparker is put up in a neat box and mounted on the dashboard of the automobile, where it is always at hand. It differs from a spark coil, as there are no vibrating parts, the opening and closing of the primary circuit of the step-up transformer being driven mechanically from the shaft of the engine. In this way there are only two moving parts, which are easily taken off and replaced. The sparker, it is said, takes less current than an ordinary coil and makes it possible to run a four-cylinder car on six dry cells. The action is positive, and by opening the case it is easy to test the device so as to detect a missing cylinder. Moreover, a switch on the sparker enables the engine to be started on a spark. The company showed also a number of switches designed for automobile purposes, and small portable dead-beat ammeters and voltmeters. J. B. Lucas was in charge of the exhibit, assisted by E. W. Dunning.

The Joseph Dixon Crucible Company, Jersey City, N. J., exhibited graphite crucibles and various other articles. One interesting feature of the exhibit was a large crucible which had been through eighty-four fires and was still in fair condition. The company is calling special attention to its graphite wood grease, intended for the transmission gears of automobiles. This was shown in various packages, as well as in a working gear case. Various other well-known Dixon graphite lubricants were shown, and a neat souvenir was given away, by means of which the proper grease for any part of the automobile can be at once determined, and the horse-power of an engine found from the dimensions of the cylinder. The company was represented by George E. Long, its secretary; L. H. Snyder and John H. Baird.

The Eastern Carbon Works, Jersey City, N. J., exhibited a full line of Eastern gas-engine dry batteries for ignition purposes, also showing the Eastern battery connector, which locks the nut by means of a rubber washer. The company was represented by A. D. Spear and Oliver Turgeon.

The Electric Storage Battery Company, Philadelphia, Pa., exhibited the well-known Exide battery. Types designed for vehicles and for ignition purposes were shown, and a sectioned cell made clear the construction of the battery. Various sizes of ignition sets were on exhibition. These are neatly mounted in handsome wooden cases. The company was represented by F. B. Neely, W. W. Kallam, T. B. Headley and F. F. Sampson.

The General Electric Company, Schenectady, N. Y., showed a line of automobile motors and controllers, and several mercury rectifiers for battery charging. There was also on exhibition a well-arranged switchboard for garage purposes. The company was represented by E. W. Mussey, W. D. Jennings and H. Van Weiland.

The Gould Storage Battery Company, New York city, exhibited the Gould batteries designed for automobile purposes. Various sizes of sparking sets, neatly put up, were shown, as well as cases of vehicle cells. A tray of the EP cell for truck use, and another of the TP cell for wagons, were shown, as well as sectioned cells showing their construction. Particular attention was called to the method of construction and formation of the positive plate of this battery. The company was represented by H. A. C. Fay and W. H. Conant.

The National Battery Company, Buffalo, N. Y., exhibited wagon and carriage batteries, including one tray of 23 W. B. cells for wagons and three trays of the 9 C. B. cell for carriages. Six-volt, sixty-ampere-hour ignition sets were also shown, as well as parts of the cell, including grids and pasted plates before and after forming. The company was represented by W. H. Thorpe and C. L. Simmons.

The National Carbon Company, Cleveland, Ohio, made an excellent exhibit of "Columbia" dry cells, all sizes, and called particular attention to those intended for ignition purposes. The igniter set shown is put up in a neat case, making it very convenient for automobile purposes. "National" jump spark coils were shown, as well as small portable flash-lights. The company was represented by M. H. Moffett.

National Electric Light Association Committee to Formulate Model Contract and Specifications for Street Lighting.

A new committee, appointed by President Williams of the National Electric Light Association, has been created for the purpose of formulating a model contract and specifications for street lighting. A great many inquiries have been made for such a contract—one that would be fair both to the lighting company and to the municipality, and one that would permit of changes in the form of illumination, as new developments were made in the art, on a basis satisfactory to both parties to the contract.

The personnel of the committee is exceptionally strong, the members being Dudley Farrand, Louis A. Ferguson, Paul Spencer, Charles P. Steinmetz and A. E. Kennelly, and very happy results are looked for in the report to be presented at the thirtieth convention of the association, to be held in May or June next.

Demonstration of the Telharmonium.

The Eastern Telharmonium Company gave a demonstration of the new electric music at Thirty-ninth street and Broadway, New York city, on January 11. The station and demonstration rooms were opened to the public for the first time on January 14. A feature of the preliminary working plan of this company is the wide publicity campaign which has been conducted. Descriptions of Dr. Cahill's beautiful invention have been published in the press throughout the country.

Illuminating Engineering Society.

The annual meeting of the Illuminating Engineering Society was held at the rooms of the Electrical Club, New York city, Monday, January 14. After an informal dinner the society proceeded to the election of officers and to hearing reports.

The report of the secretary, Dr. A. H. Elliott, was read by Preston S. Millar. This outlined the rapid growth of the society, which has now a membership of 815.

The treasurer's report was presented by V. R. Lansingh. It shows that the society received from dues, sale of pins, etc., $4,029. It has expended for publishing the transactions, office expenses, etc., $3,591, leaving a balance in the treasury of $438.

The report of the finance committee was read in the absence of the chairman, W. D. Weaver. It explained the various expenses of the society, some of these being on account of the several local sections which have been established.

President L. B. Marks presented a report discussing briefly the work of the society during the past year and outlining the work yet to be done.

Mr. Marks said, in part:

"In reviewing our progress, it may not be amiss to pause for a moment and consider the conditions that prevailed from an engineering standpoint in the science of illumination before the organization of this society. I think it will be generally admitted that while questions concerning the generation and distribution of electric current and of gas for lighting purposes received most careful attention, the problem of obtaining the best illuminating result from electricity or gas produced was neglected. The wasteful methods that have prevailed in the distribution of illumination need no comment by me. The injury that has been wrought on our eyesight by improper lighting layouts is a matter of common knowledge.

"The society, in endeavoring to place the art on a new basis, has collected and placed on record much available information relating to this field of engineering. It has brought together to discuss these questions, electrical engineers, gas engineers, architects, designers of globes, reflectors and fixtures, oculists, chemists, physicists, manufacturers of and dealers in lighting apparatus, appliances and material—in fact, representatives of almost every field of endeavor in which the question of illumination plays a part. By the cooperation of these various interests a start has been made in the collection and publication in the transactions, of invaluable papers, discussions and data which would otherwise be widely scattered and little accessible, and advances in the art have been inaugurated that would otherwise be practically impossible.

"Perhaps one of the most important points that has been dwelt upon by the society in its papers and discussions is the urgent need of reducing the intrinsic brightness of light sources, and particularly of such sources as are necessarily within the ordinary field of vision. Happily we have tangible evidence of improvements in this regard made during the past year.

"The general acceptance of definite nomenclature and standards will be of immense service in furthering the systematization of illuminating engineering. At the present time our terminology is at best crude, and very often we are unable to avail ourselves of the benefits of valuable work done by others, because the terms used in published reports of such work are open to misinterpretation. To secure uniformity, the cooperation of the members of the lighting fraternity, not only of this country, but of foreign countries, is necessary. Much has already been done by committees to bring about the standardization desired.

"I have pleasure in announcing this evening the appointment of the following international committee of the society on nomenclature and standards:

"Dr. Alex. C. Humphreys, chairman, Hoboken, N. J.; Dr. Louis Bell, Boston, Mass.; Professor André Eugène Blondel, Paris, France; Dr. Hans Bunte, Carlsruhe, Germany; John W. Howell, Harrison, N. J.; Dr. E. P. Hyde, Washington, D. C.; Dr. A. E. Kennelly, Cambridge, Mass.; Professor Vivian B. Lewes, Greenwich, England; Dr. Edward L. Nichols, Ithaca, N. Y.; Dr. F. Schniewind, New York city; Dr. C. H. Sharp, New York city; W. D. Weaver, New York city; J. E. Woodwell, secretary, Washington, D. C.

"In the early stages of our work the criticism was advanced that many were deprived of much of the benefit to be derived from membership, for the reason that only such members as resided in New York city and locality could attend the meetings and participate in the discussions. This criticism was met, to a large degree, by the organization of the sections. There is still need, however, for the organization of a few more sections, particularly in the West and South.

"Each section may present such papers or communications as it sees fit before its members, but for the protection of the society the council exacts that no paper, discussion, communication or report shall be printed in the transactions of the society unless approved by the general committee on papers. It is, therefore, important that papers be submitted to the committee as far in advance of their presentation as possible, in order to insure nearly simultaneous presentation before the several sections of the society.

"With the changed conditions that have been brought about by the formation of sections since the date of organization of the society, the present constitution is wholly inadequate for the proper government of the society. When the present constitution was drawn up we had a strictly local organization. To-day we have a federal organization with local sections. The underlying idea of the new constitution is to keep the federal organization intact. To accomplish this purpose the constitution provides for the general government of the sections and clearly defines the relation of the local sections of the federal body. It provides for the election of one vice-president of the national organization for each section of the society. The vice-president will thus be a link between the local organization and the general council of the society, and, together with such directors as may be elected from the locality of any section, will represent that section in the general council.

"Federal officers will be nominated by a board of nomination instead of by the membership at large, the board of nomination to consist of two junior past-presidents and of a specific number of past vice-presidents representing all of the sections of the society.

"During the year the transactions have increased from a forty-page number to a 100-page number. Several numbers have been issued containing nearly 400 pages of reading matter. The report of the finance committee shows that the expense of this publication has reached a point beyond which, with the annual dues of only $5, and present running expenses, we can not well afford to go until the membership of the society increases substantially.

NEW HEADQUARTERS.

"The council has authorized the lease of an office in the Engineering Societies' Building, New York city, for the general headquarters of the society. This office

has been opened with Miss E. Westervelt, the assistant secretary, in charge.

"The new administration which is to be inaugurated this evening will have upon its shoulders a task by no means light. The past year has witnessed only the beginning of the movement to give to illuminating engineering a recognized status. The real work of placing the art of illumination on a new basis and systematizing the practice of illuminating engineering is yet to be done and will require years to accomplish. To bring about the desired results, cordial cooperation between the sections of this society is a prerequisite. With the close relation between the general council of the society and governing body of the local sections, as contemplated by the new constitution, nothing should stand in the way of such cooperation."

A letter from Thomas A. Edison was read, in which he thanked the society for the invitation to attend the dinner, but regretted his inability to do so on account of a severe cold.

The committee of tellers reported the election of the following officers:

President, Dr. Clayton H. Sharp.

Vice-President, Dr. Louis Bell.

Managers, E. L. Elliott and J. E. Woodwell.

Secretary, V. R. Lansingh.

Treasurer, A. H. Elliott.

The committee reported that the new constitution had been adopted by a vote of 144 to 23.

In taking the chair President Sharp thanked the society for the honor it had done him. He said that the coming year would be a critical one in the history of the organization; that if the success of the past year is to be continued, the enthusiasm and interest of all members must be kept up. They should feel a personal responsibility in this matter and endeavor to attend meetings and otherwise evince their interest. If this year can be carried through successfully there seems no doubt of the society's continued success. The adoption of the new constitution introduced a new phase, as the government of the local sections is left largely to them and it is the function of the federal organization to keep these in touch and watch for the interests of the society as a whole. As a new constitution had been adopted, President Sharp announced that a meeting of the board of nomination would be held shortly to fill the vacant offices in the federal organization. It would also be necessary to revise the by-laws.

The meeting was then adjourned.

Meeting of the Street Railway Association of the State of New York.

The fourth quarterly meeting of the Street Railway Association of the State of New York was held at the Iroquois Hotel, Buffalo, N. Y., Friday, January 11. About fifty members were present, and a number of interesting and valuable papers were read and discussed. The meeting was called to order by President J. N. Shannahan, of Gloversville, who stated that the executive committee had determined to devote the entire meeting to a discussion of track, roadway and overhead lines, and that all the papers were confined to these branches of railway work.

The first paper was by I. E. Mathews, engineer of maintenance of way, Rochester Railway Company, and was entitled "Track Construction on Paved Streets."

A paper on "Concrete Stringers and Concrete Stringers with Ties and Steel Rails," was presented by F. D. Jackson, superintendent of track, International Traction Company, Buffalo.

E. P. Roundey, superintendent of track, Syracuse Rapid Transit Company, read a paper entitled "Tie Plates and Braced Tie Plates and Tie Rods."

As these papers were all related, the discussion on the three was taken up at the same time. Those taking part in it were F. A. Bagg, LeGrand Brown, M. J. French, C. H. Clark, B. Penoyer, T. W. Wilson, A. H. Stanley, R. P. Stevens, C. B. Fairchild, Jr., J. D. Evans, W. A. Heindle.

A paper entitled "Standard Rail Sections for Paved Streets," was read by C. Gordon Reel, general manager, Kingston Consolidated Railway. This discussed at length the use of T rails for city streets. The paper was discussed by R. E. Danforth, C. H. Clark, F. A. Bagg, W. R. W. Griffin, M. J. French, Stuart Wilder, J. D. Evans, A. H. Stanley, LeGrand Brown, T. W. Wilson and E. P. Roundey.

Two papers were read upon rail welding, the first by M. J. French, engineer of maintenance of way, Utica & Mohawk Valley Railway Company, entitled "Thermit Welding," and the other by P. N. Wilson, roadmaster, Rochester Railway Company, on "Electric Welding." The discussion on these two papers was taken up simultaneously, those participating being T. W. Wilson and C. H. Clark.

The meeting was then addressed by Professor B. B. Swenson, who spoke of the welfare of the association, after which it was adjourned for lunch.

The afternoon session was called to order at 2.30 o'clock, and the discussion on rail joints continued. Those entering into it were A. H. Stanley, C. H. Clark, C. G. Reel, M. J. French, E. P. Roundey, T. W. Wilson, F. D. Jackson, LeGrand Brown, P. N. Wilson.

A general discussion on "Derailing Devices" was held, those taking part being A. H. Stanley, T. W. Wilson, C. A. Coons, C. H. Clark, E. P. Roundey, P. N. Wilson, W. J. Harvie, G. E. Ebeleth.

A paper was presented by H. L. Mack, superintendent of line, International Traction Company, Buffalo, entitled "Rail Bonds." It was discussed by C. H. Clark, E. P. Roundey, LeGrand Brown, P. N. Wilson, M. J. French, E. E. Hawkins, C. H. Wilson, A. R. Meyers, J. E. Duffy, G. A. Harvey and R. P. Stevens.

A paper entitled "Span and Catenary Construction" was presented by G. E. Ebeleth, Schenectady Railway Company. This paper was discussed by F. A. Bagg, A. R. Meyers, C. G. Reel, J. H. Pardee, C. H. Clark, H. L. Mack, W. R. W. Griffin and M. Sheehan.

An invitation was received from the International Railway Company for the association to inspect its shops and equipment.

The meeting was then adjourned.

Advantages of Overhead Trolley in Winter.

The recent experience of the London County Council tramways under Arctic conditions has not strengthened the arguments of those sections of the public and engineers who are all for the abolition of the overhead system in favor of the underground-conduit system. Granted that the conditions which caused the serious interruption of traffic last week are not usual and were not expected, it is still hard to account for the unpreparedness of those in charge of the London County Council tramways. In happy contrast to this comes the news of the capabilities of the overhead system in Liverpool, where not only was the service maintained without mishap, but the trams were of great assistance in clearing away the snow by drawing trolleys of salt over the city, thus enabling the salt to be distributed rapidly, and making it easy work for the firemen to wash down the streets afterward. Wolverhampton also suffered by not having an overhead system of tramways, and the service had to be discontinued. We have not yet heard of any case where an overhead system of tramways in England has failed owing to the recent snow, so that, at a time when the telegraph wires are being broken down by snow and by the force of the gales we have been experiencing lately, it speaks well for modern overhead tramway practice that it should have passed through the ordeal so successfully, and once again helps to prove that the supposed dangers and disadvantages of the overhead system are more fancied than real.—*Nature, London.*

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Magnetic Susceptibility of Mixtures of Solutions.

An investigation of the magnetic susceptibility of mixtures of solutions of salts of copper, manganese and aluminum has been made by H. W. March. A slight modification of Quincke's manometric method was used, the solution being placed in a glass tube having a smaller capillary tube drawn out from the lower end and turned up at right angles. The meniscus of the solution in the capillary tube was watched by means of a microscope when it was placed in a magnetic field and the strength of the field varied. The intensity of the latter was measured by a bismuth spiral. The susceptibility of the various mixtures has been calculated, and these values compared with the actual results obtained. It was found that by computing the susceptibility of the different salts in solution and adding these together a figure is obtained which agrees with the observed susceptibility very closely. The agreement is thought to be sufficiently good to establish the fact that magnetic susceptibility is additive for the solutions examined. The three metals studied were selected because these particular metals are the ones which are used in preparing the Heusler magnetic alloys, and it is pointed out that the susceptibility of these alloys is not an additive property.—*Abstracted from the Physical Review (Lancaster), January.*

The Reduction of Mining Costs by Electric Operation.

The efficiency of the electric drive in mining works is discussed here by Dr. Alfred Gradenwitz. An interesting part of the article is the description of the storage battery system used at the Gewerkschaft Carlsfund mines in Germany, whereby the load on the generating station is equalized. The plant was originally equipped with one 100-kilowatt polyphase generator and two smaller ones rated at fifty and thirty-five kilowatts, respectively. Although the average load was about thirty kilowatts, on account of the great variations it was necessary to run the largest machine continuously. It was decided to install a storage battery of 648-ampere-hours capacity. This battery is connected directly to the terminals of a direct-current machine, from which it is charged during light loads. This machine is driven by the thirty-kilowatt polyphase generator running as a motor. On the same shaft was mounted a single-phase rotary converter, power for which is supplied by a series transformer in one of the three-phase mains. Direct current from this rotary is passed through a second winding on the field of the direct-current generator, the connections being such that the latter opposes the normal shunt excitation. During periods of light load the voltage of the direct-current machine is high, and it therefore charges the batteries. As the load increases the voltage of the generator decreases, until it finally begins to operate as a motor, driving its motor as a generator and thus supplying power to the system. By this means the load curve is smoothed out very markedly, and it was found possible to carry it by means of the fifty-kilowatt generator, except during the periods of heaviest load.—*Abstracted from the Engineering Magazine (New York), January.*

The Pollak-Virag System of Rapid Telegraphy.

In this description of the Pollak-Virag system of rapid telegraphy, D. Korda mentions some of the latest improvements made in this interesting system. The Pollak-Virag system consists in sending, by means of two wires, two series of electrical impulses varying in intensity, polarity and phase to receiving apparatus which consists of a small mirror mounted on three points, two of which are acted upon by telephone diaphragms. This is effected by the current impulses. By this means a beam of light reflected from the mirror is caused to write the message on a sensitized strip of paper. The message is sent by passing a perforated strip of paper through the sender, the perforations corresponding to the various letters and, according to their position, varying the direction and the intensity of the applied voltage, and these values, in connection with their phases, write the message in long hand on the receiving paper. The voltage of each circuit may thus be varied to plus or minus five, or plus or minus ten volts. In order to avoid the disturbances which would be set up if the telephone diaphragms were allowed to vibrate in their natural periods, a condenser is connected in parallel with each receiver, which is charged during the period of closed circuit and is discharged when the circuit is opened. In this way the motions of the telephone diaphragms are made positive, interference due to their own periods being avoided. To write the message in page form a straight filament incandescent lamp is used, surrounded by a shield provided with a helical slot. This shield is revolved and thus, by varying the position of the source of light, causes the beam reflected from the mirror to travel across the paper. The message is thus written out line after line diagonally across the sheet.—*Translated and abstracted from L'Éclairage Électrique (Paris), December 29.*

Long Spans for Power Transmission Lines.

An analytical study is made here to determine what length of span will make the cheapest pole line for various sizes of wire. The longer the span the fewer the poles required. At the same time the stronger and longer must be the poles. It is assumed that the cost of cross-arms and insulators will increase in the same proportion as the poles. The problem resolves itself into finding the minimum weight and cost of poles required per unit length of line. A lattice type of pole is considered, and a formula is deduced which involves the second power of the length of the pole. To obtain actual values it is necessary to consider specific sizes of wire. Three sizes are considered, calling for three sizes of pole. It is found that the length of the cheapest span increases with the size of the wire, and under the conditions assumed for the smaller wires it is about 260 feet, and for larger wires about 400. If the size of the poles be increased with the increase in the length of the span, as well as with the increase in the size of the wire, it is found that the cheapest span is a little shorter than before. If rental must be paid for the ground upon which the poles are placed, as this is proportional to the number of poles it will tend to lengthen the most economical length of span.—*Abstracted from the Electrical Review (London), December 28.*

Rubber Cultivation in the East.

A brief account of the rubber exposition held lately in the Royal Botanic Gardens at Peradeniya, Ceylon, is given here by J. C. Willis. Much interest was excited at this exposition by some of the newer methods of curing rubber. The method introduced by John Parkin consists in mixing with the latex a certain quantity of acetic acid and a little alcoholic solution of creosote. These two compounds are believed to be the essential elements of the smoke used in curing rubber in South America. The result of this treatment is to coagulate the rubber and clot it into a perfectly clean biscuit, which is rolled out and dried and gives more than ninety-three per cent of caoutchouc. These biscuits contain more rubber than the South American article, and are clean and also bring a better price per pound; but if the twenty per cent of water contained in the South American rubber is allowed for the price for the Ceylon article is lower. Rubber was introduced into Ceylon in 1876. The trees growing from the seed then planted produced seed in 1882. In 1888 the first rubber was obtained, but in very small quantity. The planting went on slowly until 1902. It was estimated that there are at the present time 104,000 acres of land in Ceylon planted with rubber trees almost solely of the Para variety. In addition there are from 50,000 to 60,000 acres on the Malay peninsula, practically all of the Para variety. These areas are compared with the estimated acreage in Mexico, which is said to be about 100,000 acres, containing about 20,000,000 trees. There are, therefore, at the present time about 275,000 acres planted in rubber, which should eventually yield about 20,000 tons yearly, about one-quarter of the probable world's supply. A newer form of cured rubber is now being made in Ceylon. In this the rubber is passed through a washing machine and pressed into solid blocks in a hydraulic press. There is less surface offered for oxidation, and the material packs better. A new method of vulcanizing has also been developed there. The sulphur and other vulcanizing material, as well as the coloring matter, are added to the latex, so that a very homogeneous mixture is obtained. Coagulation is then brought about and the rubber prepared in the usual way. This is worked up into any article that may be required, and it is only necessary to heat it to bring about the vulcanization. In the same way fibre and other substances are added to the milk. The product, after coagulation, is pressed under hydraulic pressure and heated, giving a solid tile containing but a small proportion of rubber, which is yet strong and elastic enough for many uses.—*Abstracted from Nature (London), December 27.*

The Gas Turbine.

A description is given here of the practical results with actual operative gas turbines in France by René Armengaud. A successful gas turbine aims to combine the advantages of the gas engine with those of the steam turbine. Various plans have been discussed for accomplishing this. They are divided into three groups: hot-air turbines, explosion turbines and combustion turbines. The author has not investigated any successful turbines of the first class, but one has been constructed by Dr. Stolze, of Charlottenburg. In the second class of turbines the air-compressor is simplified and an explosive mixture is formed in the same chamber in which it is ignited. Such an apparatus gives rise to a number of explosions per second. It runs automatically after it has once started. The periodic explosions are explained by assuming that the expansion of the gas after each explosion reduces the temperature of the gases below that at which ignition takes place. A second explosion does not follow until a fresh lot of mixture has reached the igniter. The disadvantage of this type is the high velocity of the gases and the variations in pressure, which make it impractical to release more than a small fraction of the energy of the jet upon the wheel. The theoretical efficiency of such a machine is about sixteen per cent, while the actual performance does not give more than three or four per cent. In addition to this defect there are operative difficulties with the springs and valves. The combustion turbine consists of a combustion chamber supplied by a continuous current of compressed air and a continuous supply of liquid fuel. This mixture is ignited at the start and combustion maintained. A constant temperature of about 1,800 degrees is reached. The chief defect in this apparatus is the necessity for a separate air-compressor, instead of compressing the air by the motor itself. This defect is partially remedied by the diminution of losses through the walls and the possibility of an expansion which is practically adiabatic. Combustion is more complete than is possible in a working cylinder. The practical difficulties in the actual working of such a machine are that of keeping the gaseous fluid moving at a high velocity ignited. Moreover, the mixture of combustible and air must be as perfect as possible, and the injurious action of the gaseous products of high temperatures upon the parts of the apparatus must be prevented. A machine complying with these conditions has been running successfully in the shops of the Société des Turbomoteurs, of Paris, the turbine being the result of the author's work in connection with M. Lemale. The first turbine utilized a De Laval steam turbine rated at twenty-five horse-power. The combustible was gasolene. The combustion chambers were lined with refractory material. The temperature reached was about 1,800 degrees centigrade. To reduce this, a spiral tube was embedded in the combustion chamber, through which water was circulated, the steam produced being allowed to mix with the gases of combustion, reducing the mixture to 400 degrees centigrade. This apparatus, though crude, gave encouraging results. It showed that it was possible to maintain the combustion chamber and turbine wheel in operative condition, and that it was practicable to maintain a very high temperature continuously in the combustion chamber. The total power developed by the turbine was about twice that necessary to drive the compressor. Assuming an efficiency of sixty per cent for the turbine and eighty per cent for the compressor, the final efficiency of the whole device was eighteen per cent; and this was found to depend upon the pressure and temperature of the exhaust gases. It is possible to line the combustion chamber with refractory material which will withstand the high temperatures, but it is necessary to cool the wheel. A method of doing this, after reducing the temperature of the exhaust gases, is to follow the jet of hot gases by another jet at a lower temperature. This may be steam generated in a boiler which utilizes the hot exhaust gases of the turbine, and thus a part of the heat of the exhaust is recovered. A description is given of a turbine, designed by the author, capable of delivering from 400 to 800 horse-power, according to the capacity of the compressor utilized. The combustion chamber is lined with carborundum. The expanding nozzle is surrounded by a jacket space, while water is circulated through the turbine-wheel. Gasolene or other liquid fuel is delivered into the combustion chamber through an atomizer and is ignited by incandescent platinum wire. The turbine runs at 4,000 revolutions a minute and is regulated by a throttling valve in the air-admission pipe for small speed variations, and by a change in the fuel supply for larger changes. The turbine drives three pumps—one the air-compressor, one for the cooling water and the third for the fuel supply. No experimental results of this turbine are given.—*Abstracted from Cassier's Magazine (New York), January.*

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

EDITED BY CHARLES A. PARKER.

Better Salesmen.

What can't be done?

Nothing.

All things are possible.

The job looks pretty big sometimes—looks as if it can't be done.

Let's take a hack at it, anyhow.

It looks like a brick wall, but let's buck right up against it hard.

Maybe something will give.

Anyway, maybe you can climb over or crawl under, or hike surreptitiously around the southeast end of it.

It's up to even the salesman to be something more than a mere ordertaker.

We could build automatons to take orders.

'Tisn't much.

It's like waiting for the cow to come around to be milked.

Wake up and hustle.

Get your eyes open, and look around.

There are lots of things you ought to see.

As an efficient salesman, you can't afford to miss them.

You can do business and miss them, of course, but not enough business to please the "old man" at the central plant.

Every house, and every store, and every factory, on a wired street, needs your attention and best thought.

Every one is a possible prospect.

Study the situation.

Learn all you can about the inside facts of each business concern in your territory.

Interest yourself.

Think up plans.

Study out the most plausible and practical ways to appeal to these concerns.

Keep an eye on the daily papers for new buildings, and wiring, and explosions, and fires, and births, and marriages.

Watch the seasons.

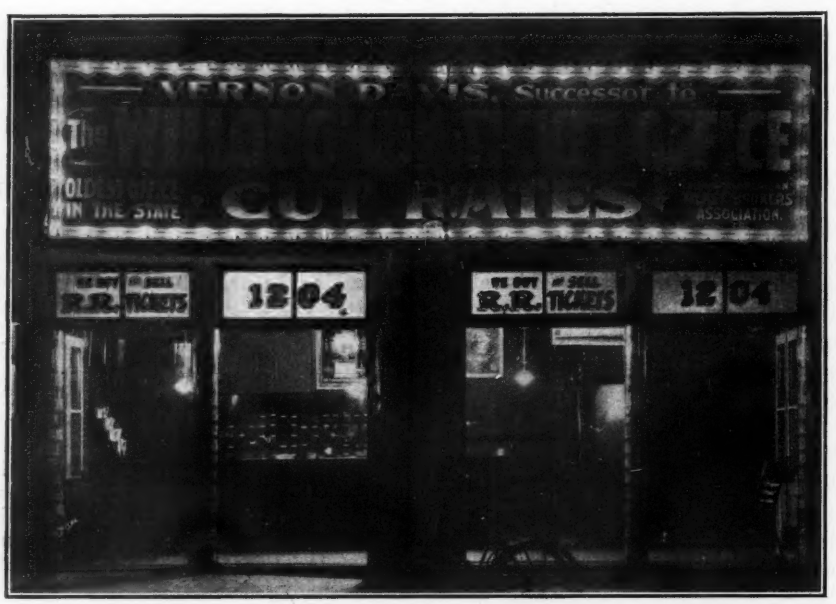
Formulate attractive and seasonable plans for spring, summer, fall and winter.

All these things are fraught with relevant possibilities for the securing of new or more business, if you only think it over in the right way.

Most of the things that can't be done, can be done.

Never mind what the salesman before you couldn't do.

What is impossible for one man is easy for another.



An excellent example of new-business enterprise in suggesting the usé of electric lamps as a border to the large display sign over entrance to office.

A few years ago publishers said it was impossible to successfully make a ten-cent magazine.

Now, that is the price of the best.

A while ago, nobody believed that a machine could be made that would talk.

Now we're entertained by one on every corner, and in every parlor.

Brute strength doesn't always move things.

Knack counts more than brawn.

Remember, every possible prospect can be landed when the right man happens along.

It's up to you to be that "right man."

You can't be him by waiting comfortably around until some concern makes up its own mind, in its own good way and time, and hands the contract into your open hand.

You can be "that man" by keeping everlastingly alert to all conditions, and not being afraid of a little insomnia, caused by thinking up new plans and schemes under the bedclothes.

The "old man" at the central plant did that.

Likely he is doing it yet, for all you know.

Likely he works harder and longer than any of you.

A little thought and study and scheming won't hurt the rest of us.

Some day we might be invited to take the "old man's" chair, when he's done.

Under this heading we shall, from week to week, present to our readers a little series of inspirational aphorisms (original, aboriginal and selected), which will, we believe, prove stimulating and suggestive to those who are interested directly or indirectly in the sale of central station current.

Try to be as good a listener as a talker.

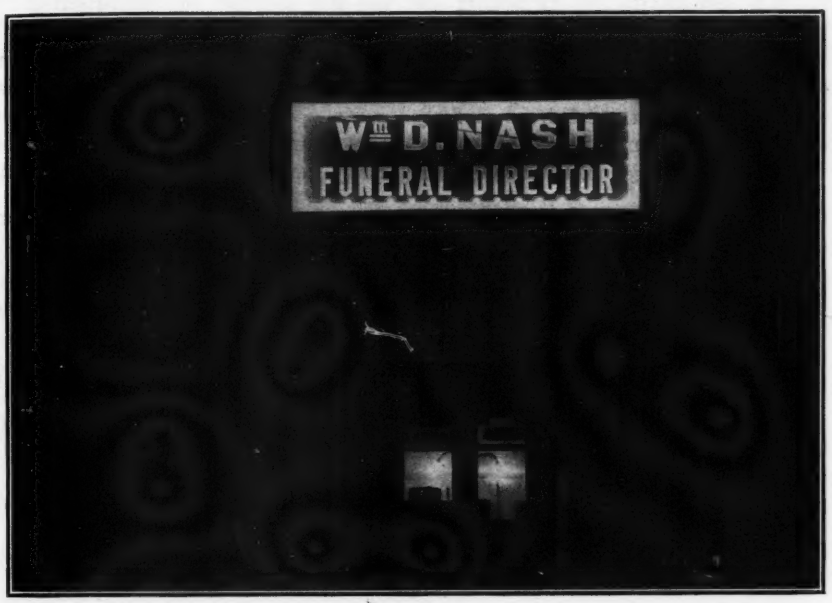
Don't tell a customer he should use current because some one else does—it's irritating.

Sell current on its merits.

Stick to your man as long as there is a chance of doing business.

Don't show your customer that you are

overawed by his mahogany desk or Persian rug; act as if you are accustomed to these things.



An electric sign gracing the portals of an undertaker's establishment is no common sight, but out in the West where people never die—but dry up and blow away—it is necessary for the undertakers to do something to get business. This notable sign is one of the Denver Gas and Electric Company's installations, and is a monumental land-mark to the energy and hustle of that unusually aggressive company.

Remember always "business before pleasure."

Don't get sociable.

Sociability will seldom get you an order.

People, as a rule, have more confidence in strangers than in friends.

Any dead one can float with the current, but it takes a live one to swim upstream.

Under this general heading we shall present to our readers a series of bright, stimulating talks to solicitors, which, we believe, will prove valuable to managers of new-business departments in suggesting points which they can profitably bring out in their occasional meetings with the company's representatives.
We shall gratefully accept contributions and suggestions from any of our readers.

Say, fellows, how many of you have noticed the advertising this company is doing in the newspapers?

I don't believe any of us pay sufficient attention to this subject of advertising.

Now, we ought to.

We ought to know exactly what this company is saying through the medium of printer's ink to the people of this city.

And I'm reminded especially of this by the fact that we have just contracted for a campaign of direct-by-mail advertising which will go, not only to our present customers, but also to all our customers and prospects among stores and business places, power users, and residences on wired streets.

Now, this advertising will be bright and forceful and a credit to this company, and it is especially intended to help you.

Salesmen are apt to think that advertising is something they must be very careful of, or it is liable to turn around and do them out of a job.

Now, I want to tell you fellows, as strongly as I can, that it is not the idea or office of this company's advertising to supplant or supersede our salesmen, our solicitors.

No advertising, however good, can take your place and actually close business on the right basis with the people.

This advertising is intended to help you.

To make your path easier.

To break the ice.

To make definite appointments for you.

To save you time.

To increase your chances for getting business.

And it will!

That has been proven a thousand times.

Now, here's what I'm going to do.

I'm having each of you fellows put right on our mailing list to receive every piece of this advertising.

And it will be sent to your home address.

I want you to keep in touch with what we're doing.

This beautiful electrical installation hails from Chattanooga, Tenn.; during the year in almost every city there is some special event or occasion which calls for the liberal and free use of good electrical illumination—are *you* doing your best to encourage and foster such occasions and events?

I want you to know what we're telling the people.

I want your criticism or comment from

time to time as you have occasion to advance such ideas.

Will you do this?

And, will you remember always that the company is spending this money primarily to help you?

It will be our endeavor, from week to week, to present in this department brief notices of activities among the central stations, as gathered from men who are in the field and, consequently, in close touch with the progress of the new-business idea and its acceptance by central-station managers. Contributions to this department are solicited, and will be received with much appreciation by the editor.

If you are doing something a little better than or different from the other fellows, and think it would make interesting reading to ELECTRICAL REVIEW readers, send in your schemes and plans. They will be gladly received.

Address all communications to Charles A. Parker, care of the ELECTRICAL REVIEW.

At Salt Lake City, Utah, is another central plant which puts its faith and work in advertising that reaches its people direct-by-mail. This is sent out month by month with statements, bills, etc., etc.

Every piece of advertising sent out is practically sure to reach its destination and get attention, and that it does so, not in theory but in fact, is proved by the splendid results these people are securing.

Such aggressive, irrepressible, insistent advertising, going out in its educational missionary work, regularly every so often, is bound to familiarize and impress the people with the importance and advantages of electricity, as well as to narrow the gulf which separates them from the central station.

What the Salt Lake central plant has accomplished goes far to prove that the sooner the central company gets down on an every-day business-like basis, the sooner the public will regard electricity as a thing to be desired.

As an evidence of what this company has done during the past year, the following figures are given:

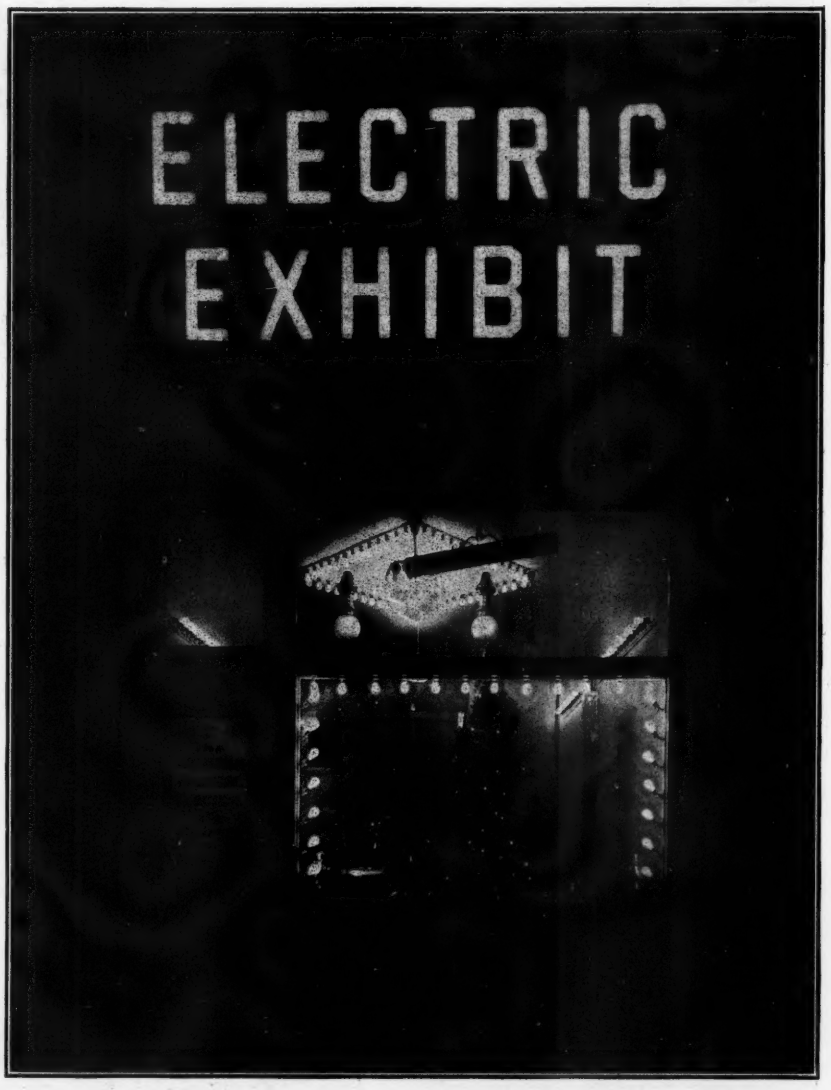
"For the first nine months of 1906, ending September 30, 1,800 new customers were added to our mains in this city in the residence district. During the same period 1,000 horse-power in electric motors was added to our power load, a large percentage of which is represented by small motors, both alternating current and direct current. From January 1 to November 1, 1906, 5,000 electric flat-irons were sold in Salt Lake City, of which number 3,000 were for local delivery, and are now connected to our lighting mains.

"Assuming the average household iron to be a four-ampere unit, and that the average time consumed in ironing in an ordinary home is two hours, four times each month, we estimate that the approximate revenue from these irons is forty cents per iron per month.

"We have now connected in the business district over 200 electric signs, the net revenue from which for the year 1906 we estimate at approximately $15,000. (Less than eighteen months ago, we did not have more than twenty-five electric signs in the entire city.) Of the number now connected most are on a flat-rate basis and are operated on a dusk-to-midnight schedule.

"All of the above has been accomplished without the aid of a regular soliciting force, and while a large percentage is due to the natural growth of our city, still we are able to trace a goodly share of the increase to our direct-by-mail campaign of advertising."

The Waynesboro Electric Light and Power Company, Waynesboro, Pa., is a pretty live member in the matter of current selling, and enjoys a condition which many central station men would envy, due to the fact that its day load constantly runs well ahead of the night load, even in the winter when the peak is between 4 and 6 P. M. Although its central station is comparatively small, the company keeps right up to the minute in the matter of studying new lamps, etc., and is progressive enough to offer "Gem" filament lamps to its customers, with the additional attraction of promising free renewals on same.



The Minneapolis General Electric Company, Minneapolis, Minn., has long been an energetic exponent of the "shining-example" theory in central station commercial practice—there is no doubt that nothing has a more wholesome effect in influencing the demand for current than to see a central station making liberal use of electricity in its own advertising and display.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

"Transite" Fireproof Asbestos Doors.

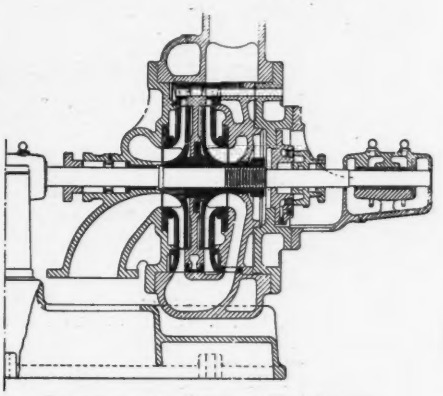
The H. W. Johns-Manville Company, New York city, is prepared to furnish "Transite" fireproof lumber in a variety of forms for fireproof construction and electrical work. The accompanying illustration shows how this material is used for closing high-tension transformer compartments and switches where these are separated by brick walls. "Transite" is a fireproof sheathing, the basis of which is asbestos fibre. It is mechanically strong and has a density which makes the finished material practically non-absorbent and possessed of high heat-resisting properties. It will stand rough usage and is easily worked, being cut, nailed or screwed very much the same as ordinary lumber.

FIREPROOF DOOR FOR SWITCH CHAMBERS AND TRANSFORMER COMPARTMENTS.

Centrifugal Pumps.

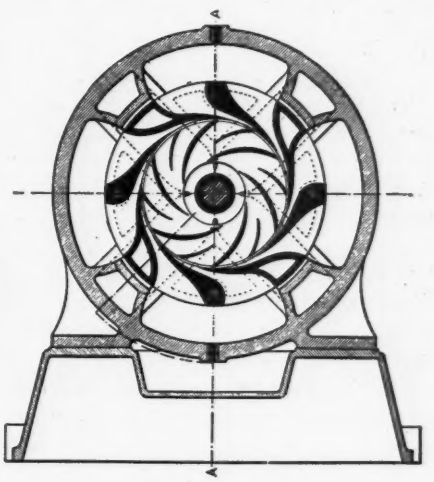
The accompanying illustrations give a pretty good idea of the appearance and design of a new centrifugal pump which has been placed upon the market by the Buffalo Steam Pump Company, Buffalo, N. Y. The company claims for this pump a high efficiency and great durability. The maintenance cost is very low, because of the fewness of the parts and the elimination of wasteful lubrication. It is also a fact that the centrifugal pump can handle gritty or acid liquids. The absence of valves makes it especially adapted for this character of service. Due to the high peripheral speed the centrifugal pump occupies a small amount of space, and, particularly for mine work, this feature is of considerable advantage.

Centrifugal pumps may be divided into two distinct types, namely, the volute and the turbine types. The company suggests that while the volute type is more essential for lower heads and where maximum efficiency is not absolutely necessary, the turbine type is used where high heads and maximum efficiency are required.

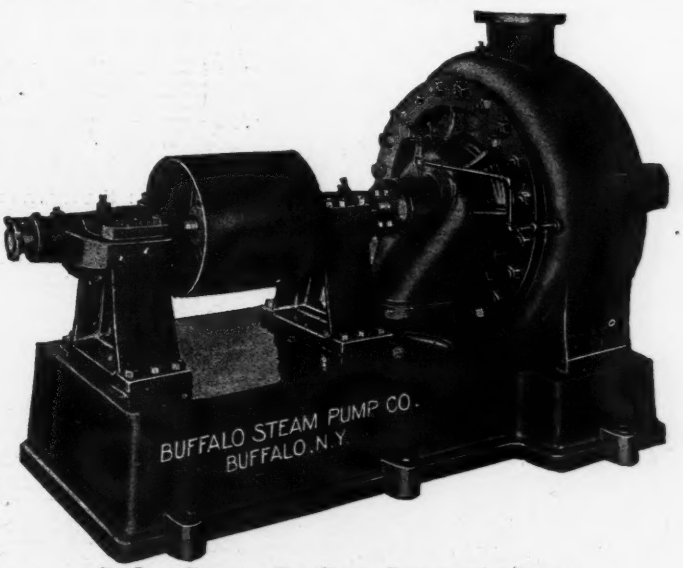


LONGITUDINAL SECTION, TWO-STAGE CENTRIFUGAL PUMP.

All types of centrifugal pumps consist of two essential elements: first, the rotating impeller, which receives the water entering at the inlet; and, second, a stationary waterway contained in the outer shell, which receives the water thrown from the edge of the impeller. Upon the design of these two elements rests the secret of the success of the pump and the efficiency obtained. In these pumps the proper proportioning of the throat and the correct curve for the vanes in the diffusion rings are the result of many tests covering several years' experimentation. The general form of the passageway in which the water finally finds its way to the outlet of the pump is that of an Archimedes spiral—that is, the cross-section increases in an arithmetic ratio up to the full area of the pump discharge.



ENLARGED SECTION, TWO-STAGE CENTRIFUGAL PUMP.



SIX-INCH BUFFALO TWO-STAGE CENTRIFUGAL PUMP.

The company has prepared in booklet form a large amount of data, including

tables of capacities of centrifugal pumps, giving the cubic feet, gallons, revolutions per minute and other statistics for heads varying from five to 100 feet. These tables also cover velocities in the discharge pipe of from twelve to fifteen feet per second.

Experiences with a Tirrill Regulator in the Electricity Works at Wels, Austria.

A paper read by Director Klicpera before the Austrian Association of Electricity Works, printed in *Electrotechnik und Maschinenbau,* September 23, 1906, page 764, describes an interesting demonstration of the value of the Tirrill regulator in securing good voltage regulation under unusually difficult conditions.

The small water power plant at Wels supplies about 1,200 incandescent lamps and fifty horse-power in small motors, in addition to about 300 horse-power in motors installed in a paper and pulp factory. The transmission line to this factory is about ten miles long, and its load fluctuations range between fifty and 300 kilowatts, as shown by a recording wattmeter chart, reproduced in the illustration, Fig. 1. Under these conditions the switchboard attendants were unable, even with the most careful work, to obtain better voltage regulation than that shown in the recording voltmeter chart, Fig. 2, in which it will be noted that voltage fluctuations ranging between 110 and 118 volts were not eliminated.

Such poor regulation, and the strain put upon the switchboard attendants to obtain even this unsatisfactory result, caused the works management to try automatic regulating devices, and an electromagnetically operated automatic rheostat was installed. This device relieved the switchboard attendants, but did not improve the regulation to the desired amount, as will be noticed by inspection of the voltmeter chart, Fig. 3. The inherent time-lag of the electromagnetic rheostat prevented the device from following the load fluctuations rapidly enough, and the management decided to try a Tirrill regulator, an American invention made by the General Electric Company, Schenectady, N. Y.

The Tirrill regulator has now been in use for one year, during which period it has been in constant service without any failure, and without requiring any attention whatever beyond the occasional cleaning of the short-circuiting contacts with emery paper. Constant potential is obtained, as shown in Fig. 4, notwithstanding the large load fluctuations, and without requiring any help from the switchboard attendants. As a result of this experience, Director Klicpera warmly recommends the use of Tirrill regulators for electricity works laboring under objectional potential fluctuations due to heavy load fluctuations.

It will be recognized that parallel conditions exist in this country, in which there are many more combination light-

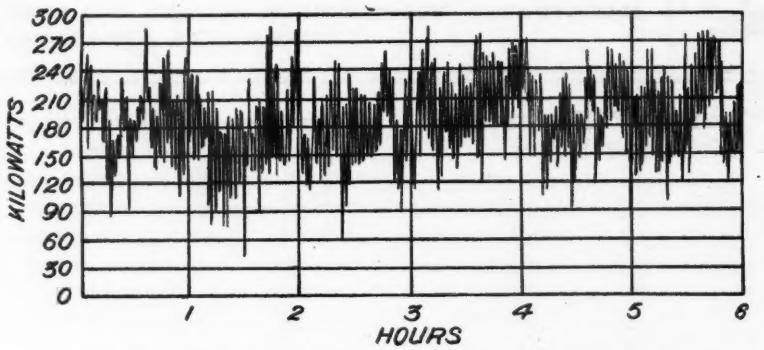


Fig. 1.—Showing Load Fluctuations on Transmission Line.

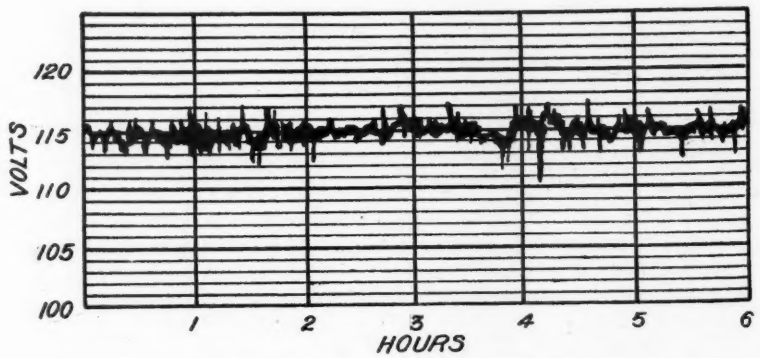


Fig. 2.—Voltage Fluctuation with Hand Regulation.

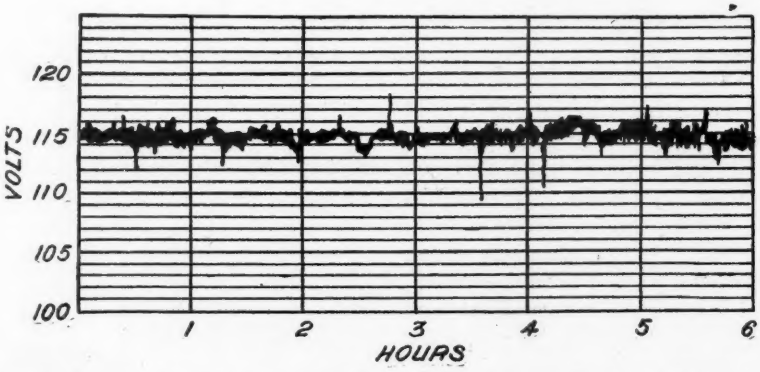


Fig 3.—Voltage Fluctuation with Electromagnetically Operated Automatic Rheostat.

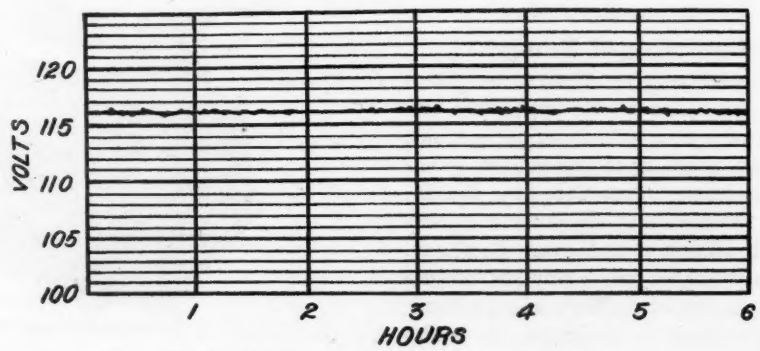


Fig. 4.—Voltage Fluctuation with Tirrill Regulator.

ing, power and railways plants than there are abroad. A comparison of the charts herewith, Figs. 2 and 3, show clearly that the best results possible to obtain with a regulator of the automatic rheostat type do not surpass careful hand regulation. Further, a comparison of these charts with the Tirrill regulator chart, Fig. 4, shows that neither hand nor automatic rheostat regulation can, in the nature of things, be expected to equal the results obtained by the Tirrill regulator method. That is to say, no rheostat and switch-arm arrangement, whether hand operated or automatically operated, can be in the same class, mechanically or electrically, with the light, continuously operated contact-making device of the Tirrill regulator, rapidly opening and closing a shunt-circuit across the field rheostat in sensitive responses to all changes of load or speed.

Annual Meeting of the Electrical Salesmen's Association.

The annual meeting of the Electrical Salesmen's Association will be held at the Grand Pacific Hotel, Chicago, Ill., on Thursday, January 24. The following programme has been announced:

2 P. M.—Meeting called to order. Business meeting: reports of committees, election of officers, new business.

6.30 P. M.—Dinner. The evening entertainment will be furnished by a fine array of speakers who will discuss the following topics: "The Sale of Specialties," "Requirements of a Successful Salesman," "Price as Compared with Quality as a Basis for the Sale of Electrical Goods," "Salesmanship."

The evening will close with a general discussion of the topic, "Which is the Most Important in the Sale of Electrical Goods, the 'House' or the 'Salesman'?"

W. S. Barstow & Company, of New York and Portland, Ore., have contracted to do all the electrical work for an 800,000-barrel cement plant to be located on the outskirts of Montreal, Can., for the Fordwick company. The works will use about 2,500 horse-power in electric motors, and will take current from the Shawinigan power plant, eighty miles from Montreal. The property of the Fordwick company is about two miles in length by 600 feet in width, along the St. Lawrence river. Provision will be made for storing, adjacent to the works, 40,000 tons of coal.

Cooper Hewitt Lamps in a Steam Room.

An interesting application of Cooper Hewitt mercury vapor lamps is found in the lighting of rooms filled with steam. The feeding mechanism of arc lamps under this condition is alleged to be a source of considerable trouble, resulting in continual repairs. For this class of work a special type of Cooper Hewitt lamp is supplied, with separate resistances, and the holder or fixture is made of brass, except for the suspension bar and crowfoot. In order to avoid leakage of current due to condensation of steam on the inside of the suspension bar, the wires leading to the tube are carried on porcelain cleats mounted on the outside of the suspension bar. The resistances are placed preferably outside the steam room, but may, if necessary, be in the same room.

A good example of this class of work is found at the plant of the John B. Stetson Company, Philadelphia, Pa., one of the largest hat manufacturing companies in the United States. The photograph gives a good idea of one of the "sizing rooms" of this company. The size of the room in question, together with the location of the lamps, is shown in the sketch; the total area of the room, less elevator and stock room, amounts to 7,240 square feet. The building is of concrete with white walls and ceilings; ceilings fourteen feet high. The lamps used are type K,

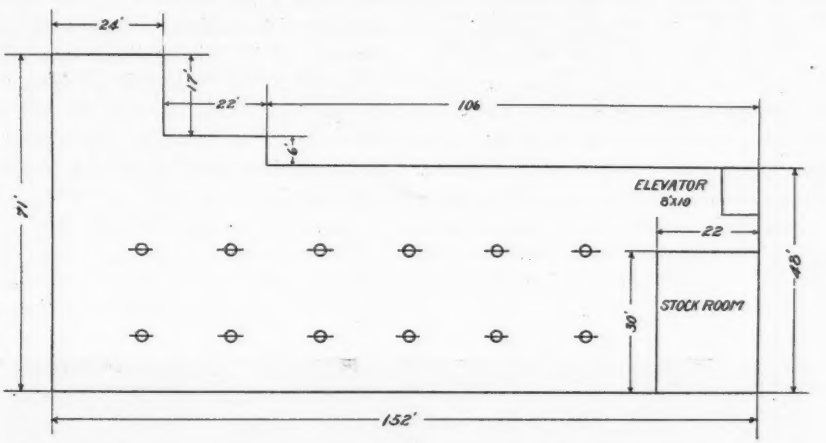
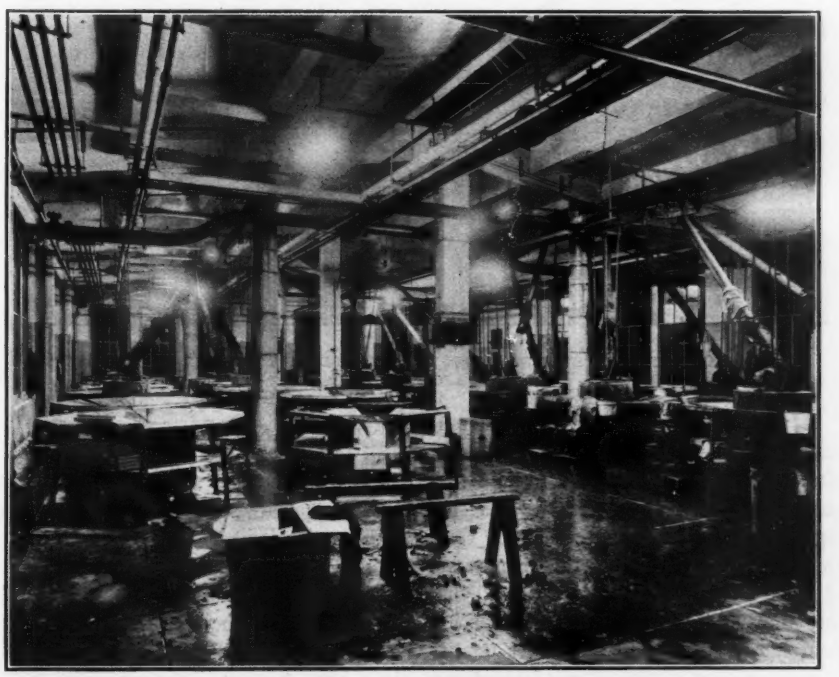


Diagram Showing Dimensions of Rooms and Positions of Mercury Vapor Lamps.



Sizing Room, Illuminated by Twelve Type K Mercury Vapor Lamps.

two in series, on 220 volts, direct current. Each of these lamps gives light from a tube forty-five inches long and one inch in diameter. With the standard reflector the average candle-power measured from the horizontal is as follows:

At 30 degrees.....	800 candle-power
45 degrees.....	955 candle-power
60 degrees.....	1,100 candle-power
90 degrees.....	1,200 candle-power

Each Cooper Hewitt lamp consumes 385 watts, or a total of 4,620 watts for the twelve lamps. This gives .64 watts per square foot of floor space lighted. Twenty-four arc lamps taking 660 watts each, a total of 15,840 watts or 2.19 watts per square foot floor area, were formerly used to light this floor until replaced by the Cooper Hewitt lamps.

TIPPING AND BRIM STRETCHING ROOM, ILLUMINATED BY TWELVE TYPE K MERCURY VAPOR LAMPS.

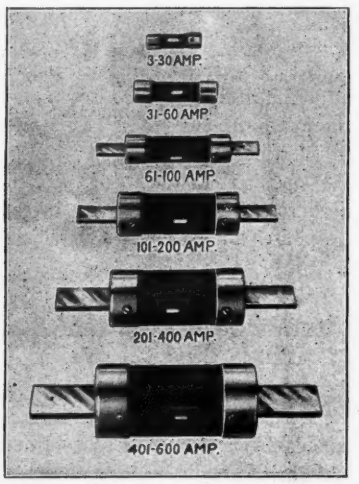
It will thus be seen that the current consumption has been reduced to twenty-nine per cent of the amount formerly required. In other words, there is a saving in current of seventy-one per cent. In addition to the saving in current, and of much more importance, it is stated that the production of the men in the room has been increased, due to the better quality and more even distribution of the light.

After a careful trial on the part of the John B. Stetson Company it has adopted Cooper Hewitt lamps for this class of work, and is now using a total of ninety-six type K lamps. The larger portion of these lamps have been in use for over a year without requiring any repairs and are said to be in first-class condition.

A Sample Board of Enclosed Fuses.

A sample board of enclosed fuses is being prepared for distribution among jobbing houses by the Chicago Fuse Wire and Manufacturing Company, Chicago, Ill. The board is shown in the accompanying illustration. The collection mounted on it includes the 250-volt National Electrical Code line of fuses and samples of old-code material for 250 and 500 volts. The fuses are constructed to the dimensions specified by the National Electric Light code for the various sizes intended for current varying from three to 600 amperes at the voltage given. The company states that these fuses have been submitted to the Underwriters' Laboratory, of Chicago, and to the Factory Mutual Laboratory, of Boston, and have been approved by them and included in the lists of approved fittings which these two laboratories issue.

The Chicago Fuse Wire and Manufacturing Company has spent a large amount of time and money in investigating the enclosed-fuse problem. Over 1,200 tests have been conducted and tables have been compiled showing the effect of the various elements which enter into their manufacture, so that the highest degree of accuracy may be attained. There are many factors entering into the design of enclosed fuses. One of the most important is the character of the powder filler surrounding the fusible element. Its functions are twofold: it must first secure a greater degree of uniformity of condition, and, consequently, a higher accuracy of rating; and, second, it must smother the arc at the time of the break. To meet these two conditions is exacting, as the filler must not be a conductor of heat or electricity, it must not absorb moisture, and it must not liberate excessive gases under the action of the arc formed by the burning of the fuse. Moreover, it must be of such material as can be prepared without undue cost. In bringing out a reliable fuse the proportions of the fusing element are of much importance. Upon its shape, thickness and length depend the amount of heat generated in the tube, the quantity of gas liberated at the time of fusion, and the nature and duration of the arc. All of these questions have been carefully investigated, and by this means the company has earned for its product a reputation of accuracy and reliability. The work was taken up when the insurance companies demanded that fusible protectors should be enclosed, and the constantly increasing business in fuses of this type has made it necessary for the company to enlarge its facilities several times.



SAMPLE BOARD OF ENCLOSED FUSES.

Besides enclosed fuses the company is prepared to furnish all old-code fuses of any type or dimension, as well as special fuses to meet the requirements of any particular class of work. The object of the company is to cover completely and thoroughly the entire field of electrical fuses. The fuse department is under the direction of C. T. McDonald, the company's electrical engineer, who has had a large part in the development of this work. His ideas of what a safe and reliable protector should be are those which are embodied in the company's "Union" fuse.

Current Electrical News

DOMESTIC AND EXPORT.

EXTENSIONS TO BE MADE TO CONNECTICUT TROLLEY LINES—It is announced that the Consolidated Railway Company, New Haven, Ct., has decided to appropriate $2,500,000 for the extension of its system during 1907.

PORTO RICO CABLE—The secretary of war has referred to the attorney-general the application of J. A. Scrymser, of New York, president of the Central & South American Telegraph Company, for authority from the president to land telegraphic cables in Cuba, Porto Rico and the Panama canal zone. The attorney-general was requested by the secretary of war to give an opinion whether the cables could be landed in Cuba without the authority of the government and congress of that republic, and in Porto Rico and the canal zone without the authority of the United States Congress.

RIGHTS SECURED FOR HOLLAND ELECTRIC LINE—Newton Carlton, president of the board of trustees of the Holland-American Construction Company, has secured important trolley franchise grants in Holland. Rights have already been secured for 200 miles of trackage, reaching from Germany to the North Sea. One of the roads has been started. Associated with Mr. Carlton in the enterprise, which is capitalized at $1,000,000, and is incorporated, are George C. Smith and Walter D. Updegraff, of Pittsburg, and several Rochester financiers.

BROOKLYN RAPID TRANSIT WINS IN CONEY ISLAND FARE CASE—The Court of Appeals, sitting at Albany, N. Y., has handed down a decision on the proceedings instituted by Bird S. Coler, president of the borough of Brooklyn, New York city, against the Brooklyn Rapid Transit Company, holding that the company is within its rights in charging a double fare on its Coney Island lines. The court holds that when the elevated and steam roads running to Coney Island were leased by the Brooklyn Rapid Transit Company their charter right to charge ten cents, or at the rate of three cents a mile, was not forfeited.

MILWAUKEE TRACTION PLANS—The directors of the Milwaukee Light, Heat and Traction Company have called the annual meeting of the company for January 21 in Milwaukee, Wis., at which the stockholders will be asked to authorize a new issue of refunding and extension mortgage bonds upon such terms and to such an amount as may be determined at the meeting, and also to authorize an increase in the capital stock, either of the present general character or to be divided into preferred and common stock. The stockholders of the Milwaukee Electric Railway and Light Company will meet on the same day and be asked to increase the common stock of the company from its present authorized limit of $15,000,000 to an amount to be determined at the meeting.

WORK ON TENNESSEE POWER PLANT STARTED—Work on the electric power plant to be erected at Caney Fork Falls (Tenn.) by C. H. Fisk and C. W. Post, of Michigan, which will call for the expenditure of $3,000,000, has been begun, and will be completed as soon as possible. The plant is to supply power to manufacturing establishments in Nashville and Chattanooga, Tenn., and includes the construction and operation of an electric railway, to connect Chattanooga with Nashville. The distance between them by steam railroad is 151 miles. It is intended to reduce the time from five hours to three hours by the new line, which will cover only ninety-eight miles. Pittsburg capitalists, it is understood, will finance the railroad, and Messrs. Fisk and Post will control the power plant.

LARGE MERGER IN SAN FRANCISCO—It is stated that one of the largest deals in financial circles in San Francisco, Cal., since the April disaster is about to be consummated in the coalition of the interests represented by the Fleischhackers, the London, Paris & American Bank, and the San Francisco Coke and Gas Company. The extensive power and paper interests of the Fleischhackers at Floriston, on the Truckee river, and the local plant of the San Francisco Coke and Gas Company will be consolidated. The companies will be financed by the London, Paris & American Bank, in which the Fleischhackers and Leopold Michaels, president of the gas company, will soon become heavy stockholders. The San Francisco Coke and Gas Company is owned to a large extent by New York capitalists. It will, it is said, derive power for electric lighting from the plant at Floriston.

$47,000,000 LIGHTING PLAN FOR LONDON—It is announced that the London (England) County Council will ask Parliament to sanction an electric-supply undertaking to serve an area of 451 miles, of which London is the centre. The councilmen propose to erect a generating station at a cost of $7,000,000, to spend $13,000,000 on a distribution system and to acquire existing local municipal undertakings representing an outlay of $27,000,000. The council urges that within a few years it will be able to supply electric power and light at greatly reduced rates and that London will gain enormous benefits industrially and commercially. The scheme includes such details as the purchase of motors and other apparatus for renting to consumers. In fact, it is the most ambitious undertaking ever put forward by the advocates of the municipalization of industries, and calls for floating a special loan of about $23,000,000 at the outset. It is conceded that some additional burden must fall upon the taxpayers, but they are expected to bear this in view of the vast benefits in store in the future.

GAS AND ELECTRIC MERGER—Gas and electric properties representing an actual investment of more than $7,000,000 have been united as a result of negotiations which have been concluded in Utica, N. Y. The interests controlling the Utica Gas and Electric Company has purchased the stock, franchises, plants, machinery, real estate and property of the Herkimer County Light and Power Company, the Glens Falls Gas and Electric Company, the Consolidated Light and Power Company, of Whitehall, and the United Gas, Electric Light, Heat and Fuel Company, of Sandy Hill, Fort Edward and South Glens Falls. For the present the several companies will maintain their separate organizations, but it is the intention to merge them into one corporation as soon as the necessary legal formalities can be complied with. It will be in effect a union of the most important gas and electric interests in the Mohawk valley and the upper Hudson valley. The Utica Gas and Electric Company is now operating in Utica, Rome, Whitesboro, Oriskany, Yorkville, New Hartford, Washington Mills, Chadwicks, Deerfield, Trenton, Frankfort and Canastota, which contain a population of about 100,000. The companies that have been acquired are doing business in Dolgeville, Little Falls, Herkimer, Mohawk, Ilion, Glens Falls, Whitehall, Sandy Hill, Fort Edward and South Glens Falls, which have a population of about 70,000. It is the purpose of those interested to extend the field of operations in all directions, to increase the production of gas and electricity and to improve the service in such a way as to secure a greater amount of patronage. The Utica Gas and Electric Company owns the power plant at Trenton Falls, which develops 8,000 horse-power, and has steam plants in Utica that are capable of duplicating that amount. The company proposes to install machinery at Trenton Falls that will bring up its capacity to 16,000 horse-power. One mile above Trenton Falls at Prospect the company has purchased a large tract of land in the West Canada creek and has plans prepared for the construction of a dam and reservoir which will produce 6,500 additional horse-power. Seven miles further north, at Enos, on the Black river, the company will build another station, having a capacity of 3,000 horse-power. This will give it a total of 25,500 horse-power generated hydraulically, aside from its 8,000 horse-power steam plants in Utica. Besides going into the electrical business on an extensive scale, the Utica Gas and Electric Company will lay mains and supply Frankfort, Ilion, Mohawk, Herkimer and Little Falls with gas generated at the Utica plant.

ELECTRIC RAILWAYS.

FINDLAY, OHIO—The commissioners have granted a franchise to the Findlay-Marion Railway and Light Company to construct its lines through Hancock county.

MACON, GA.—A site has been selected on the Ocmulgee river for the power-house for the Macon & Albany Electric Railway. Water power will be secured from the Flint and Ocmulgee rivers.

NORMAN, OKLA.—A franchise has been granted the Tecumseh & Norman Traction Company, allowing the company to use the streets of Norman for an electric railway for a term of twenty-five years.

MARSHALLTOWN, IOWA—The Iowa Railway, Light and Power Company has been formed to take over the local light and railway system and to extend interurban lines. Hamilton Browne, Geneva, Ill., is president, and Arthur T. Browne, Geneva, Ill., secretary and treasurer.

PORTLAND, ME.—Manager John R. Graham, of the Lewiston, Brunswick & Bath Electric Railroad, says that the road to Mechanic Falls will be built and in operation by July 4. The route of the proposed electric road will follow the direct carriage road from Auburn, *via* Minot Corner, to Mechanic Falls.

BATH, N. Y.—A company of Hornell and Canisteo capitalists have purchased the Hornell city electric line and the Hornell & Canisteo electric road, and propose to construct a road from Canisteo to Jasper, as an extension of the Canisteo and Hornell line. It is understood that work will be commenced early in the spring.

CARMI, ILL.—Capitalists in southern Illinois have on foot a plan to run an electric railway from Mount Vernon, Ill., to Mount Vernon, Ind., connecting with the St. Louis lines at the former place and with the Evansville service at the Indiana town. The present plan is to have the road touch Fairfield, Crossville, Grayville and other small towns, probably crossing the Wabash at Grayville.

KANSAS CITY, MO.—Work has been begun on the construction of the Kansas City, Excelsior Springs & St. Joseph Electric Railway Company's bridge across the Missouri river. The bridge will cost nearly $2,000,000, and the remainder of the line to St. Joseph, Mo., will require the expenditure of $4,000,000. By employing 1,500 men working at a dozen places simultaneously the line will be completed in eighteen months.

MUSCATINE, IOWA—It is reported that local capitalists have secured a right of way for an interurban line from Manchester, Iowa, 110 miles northwest of Davenport, to Monticello, Stanwood, Olin, Tipton, West Liberty and Blue Grass. The plan is to construct a line to Muscatine, but the plans may be changed, and if a proposition is made the line may find a terminal in Davenport. The company will be incorporated with a $2,000,000 capital, and will be known as the Manchester, Monticello & Muscatine Railway Company.

NEW HAVEN, CT.—William J. Tracy, Henry M. Osborn and Frank S. Bishop have drawn up a petition addressed to the January, 1907, session of the general assembly for a charter for an electric street railway. The line contemplated is from the centre of Danbury to the town of New Milford, a distance of fourteen miles. It is estimated that the cost of the trolley line will be from $25,000 to $30,000 a mile, or a total of from $350,000 to $420,000. There is adequate capital behind this movement, and if the charter is granted the road will be constructed immediately. The road contemplated passes through the village of Brookfield and the village of Lanesville.

LOUISVILLE, KY.—A syndicate traction line, in which will be merged the traction interests in southwestern Indiana, has been incorporated with a capitalization of $4,500,000, and it is stated that the company will ultimately build from Evansville to New Albany and Louisville. The incorporators include the Murdocks, Hugh J. McGowan and former Governor W. T. Durbin, who are interested in the traction syndicate in Central Indiana. The construction of a line from Evansville to Louisville will connect the system of southwestern Indiana with the systems in the southern, central and northern parts of the state. The Murdocks recently purchased the Evansville & Princeton line.

JERSEY CITY, N. J.—Plans have been completed for the building of an electric railroad around Lake Hopatcong, N. J., and the developing of the land about the sheet of water. A company has secured articles of incorporation under the name of the Hopatcong Shore Railroad Company. The immediate plan is to build a trolley line from the Lackawanna railroad's station at the lake to Byram Cove, but the road will eventually circle the lake *via* Woodport. The right of way is partly public and partly over the property of the Byram Cove Land Company. The company is capitalized at $100,000, and the incorporators are all interested in the Byram Cove Land Company, which owns 1,000 acres of land with two miles frontage on the lake.

ALBANY, N. Y.—The state railroad commission has approved the increase of the capital stock of the Frontier Electric Railway Company from $300,000 to $1,500,000 and consented to the issuance of a mortgage for $2,000,000. This company proposes to build an electric railroad from Buffalo to Niagara Falls. As the result of a public hearing the commission has recommended to the Tarrytown, White Plains & Mamaroneck Railway Company that new rails be laid on its line between White Plains and Tarrytown. The commission has consented to the issuance by the Western New York & Pennsylvania Traction Company of a first and refunding mortgage for $5,000,000, on condition that only $2,500,000 of bonds under said first and refunding mortgage shall be issued under this consent.

DETROIT, MICH.—The Saginaw, Owosso & Lansing Railway Company has been incorporated with $600,000 capital. The incorporators are: J. L. King, of Syracuse, N. Y., general counsel for the Solvay company and heavily interested in Syracuse electric railways; F. B. Richards, general manager for M. A. Hanna & Company, of Cleveland; George B. Morley, of Saginaw; Phil H. McMillan, George Black, Frank W. Eddy, Frank West, Charles B. Warren, William B. Cady and J. A. Thick, of Detroit. The new line will be built on a private right of way, all of which has been secured, to the east of and paralleling the Michigan Central from Saginaw to Lansing. It will touch at the towns of St. Charles, Chesaning, Owosso, Laingsburg and Bath. The road will be built with rock ballast and heavy rails, and the cars will be equipped for high speed.

HARTFORD, CT.—Several additional notices that corporate franchise privileges will be sought from the legislature have been filed. The Consolidated Railway Company will petition for important franchises in the towns of New Haven, Norwich, New London, Middletown, Wallingford and Bloomfield. The Berkshire Street Railway Company, which is incorporated in Massachusetts, will ask for the right to enter Connecticut and construct a trolley in the town of Canaan. This is for the purpose of promoting the construction of the interstate trolley from Great Barrington to Canaan. The Shore Line Electric Railway Company will seek authority to construct a trolley from Essex through the town of Old Saybrook to Colchester. A charter of incorporation will be asked for the Norwich & Groton Street Railway Company to run through several towns on the east side of the Thames river.

BUFFALO, N. Y.—The consolidation of various trolley lines operating between Buffalo and Erie has been completed. The agreement is between the Pennsylvania and New York state lines entering into the consolidation. The Buffalo & Lake Erie Traction Company merged in itself the various New York state lines, and the Erie Rapid Transit Company merged in itself the various Pennsylvania lines, and then these two corporations came together in the final merger. The result is a corporation with a capitalization of $6,750,000, this sum being made up of the capitalization of the Buffalo & Lake Erie Traction Company amounting to $4,420,000, and of the capitalization of the Erie company amounting to $2,330,000. The new capitalization is divided into 42,500 shares of common and 25,000 shares of preferred stock. The name of the new corporation is the Buffalo & Lake Erie Traction Company. Its directors are: Louis B. Grant, Brooklyn; Rodman E. Griscom, Haverford, Pa.; Albert N. Clark, Sydenham, Pa.; Charles H. Werner, New York; James A. Byrne, New York; Joseph B. Mayer, New York; Arthur McCausland, New York; Henry Gross, Philadelphia; William J. Bagnell, Brooklyn. The officers are: president, Joseph B. Mayer; vice-president, Charles H. Werner; treasurer, Marshall N. Dodge, New York; secretary, James A. Byrne.

PERSONAL MENTION.

MR. EDWARD R. GRIER, who for years has been assistant manager of the Bryant Electric Company, has just been elected vice-president of the Ajax Line Material Company, of Chicago. He will maintain his location in the Postal Telegraph Building at New York, looking after the Eastern sales of the Ajax toggle bolts and street-lighting specialties.

MR. S. M. GREER has been appointed contract agent of the Long Island division of the New York & New Jersey Telephone Company, to succeed A. R. Pardington, who resigned his position to become vice-president and general manager of the new Long Island Motor Speedway Company. Mr. Greer is an experienced telephone man, having served the telephone company in various capacities for the past sixteen years. For the last few years Mr. Greer has been secretary to U. N. Bethell, vice-president of the New York Telephone Company, president of the New York & New Jersey Telephone Company, and also president of several other telephone companies in the East.

MR. FRANK P. ALLEN, JR., has been appointed director of works of the Alaska-Yukon-Pacific Exposition which will be held at Seattle during the summer of 1909. Mr. Allen gained his exposition experience at the Lewis and Clark Exposition at Portland in 1905, where he had charge of the structural work. Mr. Allen was born in Grand Rapids, Mich., and has been an architect and engineer all his life. He secured his early training in his profession under his father, Frank P. Allen, Sr., who was a prominent architect. After taking a course in civil engineering at the University of Michigan he went to Chicago, where he spent six years, specializing on structural work for bridges, railroads and large buildings.

COLONEL JOHN T. DICKENSON, who for the past several years has been connected with the Consolidated Railway Electric Lighting and Equipment Company, has tendered his resignation and accepted the position of vice-president of the Bliss Electric Car Lighting Company, of Milwaukee. Colonel Dickenson's headquarters will be in New York at the new offices of the Bliss Electric Car Lighting Company in the Night and Day Bank Building, Fifth avenue and Forty-fourth street. The Chicago offices of the Bliss Electric Car Lighting Company will be in the Monadnock Building, and W. M. Lalor, who was formerly also with the Consolidated Railway Electric Lighting and Equipment Company, will be in charge of this office as assistant general sales manager. Extensive additions to the large plant of the Bliss Electric Car Lighting Company, in Milwaukee, will be completed February 1.

MR. HOWARD M. POST has recently accepted the position of advertising manager with the Quincy, Manchester, Sargent Company, manufacturers of railroad appliances, who have offices in Chicago and New York, with factories at Chicago Heights, Ill., Milwaukee, Wis., and Plainfield, N. J., this company being the successor to the Railway Appliances Company, The Q. & C. Company and the Pedrick & Ayer Company. Mr. Post originally fitted himself for a telephone engineer and held a position as telephone-switchboard installer with the Western Electric Company, of Chicago, for three years, superintending during that period the installation of many large telephone exchanges in all parts of the country. Later he accepted a position as telephone engineer with the Kellogg Switchboard and Supply Company, of Chicago, and during a period of five years took out a large number of telephone patents.

OBITUARY NOTE.

MR. GEORGE B. COGGESHALL died suddenly on Wednesday at his home, 37 Sidney place, Brooklyn, N. Y., in his sixty-third year. He was connected with the firm of Mitchell & Vance, manufacturers of gas and electrical fixtures. He was a civil war veteran and a member of the Mayflower Society. He leaves a widow. Mr. Coggeshall was active in the management of the New York Electric Club, organized in 1886, and was for several years a member of the board of directors.

DATES AHEAD.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.
Ohio Engineering Society. Columbus, Ohio, January 22-24, 1907.
Jamestown Ter-Centennial Exposition. Norfolk, Va., April 26 to November 30, 1907.

ELECTRICAL SECURITIES.

Considerable activity was evidenced in the stock market during the past week, there being two million-share days. This activity, however, was due mainly to professional operations, the outside public seemingly holding aloof. The latter's lack of interest is held to be due in part to the present investigations and legal actions against the large corporations. There has been a considerable easing in the monetary situation. Call-money rates at the end of the week were as low as 5¾ per cent, and time funds have also been easier in tone. There is no indication of any setback in the industrial and business condition, and railroad earnings continue to make a good showing. On January 29 the directors of the United States Steel Corporation will act on the common-stock dividend. The general opinion is that the rate will not be changed.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JANUARY 12.

New York:	*Closing.*
Allis-Chalmers common	16¼
Allis-Chalmers preferred	43
Brooklyn Rapid Transit	81
Consolidated Gas	137½
General Electric	156¼
Interborough-Metropolitan common	36¾
Interborough-Metropolitan preferred	73¾
Kings County Electric	140
Mackay Companies (Postal Telegraph and Cables) common	73¼
Mackay Companies (Postal Telegraph and Cables) preferred	71⅛
Manhattan Elevated	142¾
Metropolitan Street Railway	105
New York & New Jersey Telephone	115
Western Union	83½
Westinghouse Manufacturing Company	150

Boston:	*Closing.*
American Telephone and Telegraph	131
Edison Electric Illuminating	229
Massachusetts Electric	70⅛
New England Telephone	122
Western Telephone and Telegraph preferred.	80

Directors of the Edison Electric Illuminating Company, of Boston, have declared the regular quarterly dividend of 2½ per cent payable February 1 to stock of record January 15.

At the annual meeting of the stockholders of the Boston Elevated Railway the former board of directors was reelected, with the exception of James Phillips, Jr., who was not a candidate.

J. P. Morgan & Company, Kuhn, Loeb & Company and Kidder, Peabody & Company, in conjunction with Baring Bros. & Company and J. P. Morgan & Company, of London, have bought from the American Telephone and Telegraph Company an issue of $25,000,000 three-year 5 per cent notes, all of which have been sold. The notes are dated January 1, 1907.

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	65
Electric Storage Battery preferred	65
Philadelphia Electric	8⅛
Philadelphia Rapid Transit	20¾
United Gas Improvement	90½

Chicago:	*Closing.*
Chicago Telephone	114
Chicago Edison Light	140
Metropolitan Elevated preferred	70
National Carbon common	85
National Carbon preferred	116
Union Traction common	—
Union Traction preferred	—

Chicago's share of the net receipts from the traction companies provided for under the proposed settlement ordinances has averaged $3,645.07 a day since the first of January. This average would mean $1,330,430.55 a year. Both traction companies opened new books the first of the year with the city as a partner in the transportation business.

NEW PUBLICATIONS.

ARMOUR INSTITUTE OF TECHNOLOGY—The Armor Institute of Technology, Chicago, Ill., has issued its fourteenth annual year book, in which are described the various courses offered. The institute has also published a catalogue describing the evening courses offered in various branches of engineering.

UNITED STATES NAVY DEPARTMENT—The following reports have been received from the Navy Department, Washington, D. C.: annual report of the secretary of the navy for the year 1906; report of the chief of the bureau of navigation, and the report of the superintendent of library and naval war records.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA—The Engineers' Society of Western Pennsylvania, 803 Fulton Building, Pittsburg, Pa., has published under date of December 19, 1906, the charter as amended at a special meeting of the society, November 26, 1906, and the by-laws adopted at the 270th regular monthly meeting of the society, December 18, 1906.

THE FUNICULAR RAILROAD OF VALLVIDRERA AND BARCELONA—Jose Playa, engineer of the Compañia del Ferrocarril de Sarra a Barcelona y Extensiones, has published in Spanish an illustrated description of the electric funicular railroad between Vallvidrera and Barcelona, Spain. This publication takes up in considerable detail the solution of a number of problems connected with this important funicular electric railway system, and includes in the descriptive matter a very complete treatment of the auxiliary apparatus.

THE SCIENCE YEAR BOOK, DIARY, DIRECTORY AND SCIENTIFIC SUMMARY FOR 1907—The Science Year Book, Diary, Directory and Scientific Summary for 1907 has been issued. This volume, as usual, contains many useful astronomical and physical tables, a summary of the scientific work done during the year 1906, a directory of the scientific and allied societies of Great Britain, brief biographies of a number of eminent men of science, and a diary for the current year. The book is published by King, Sell & Olding, Limited, 27 Chancery lane, London, W. C., and sells at five shillings net.

APPROVED ELECTRICAL FITTINGS—The Electrocraft Publishing Company, Detroit, Mich., has compiled and published an illustrated list of approved electrical fittings. This is a valuable compendium upon the fittings that have been examined and approved by the Underwriters' National Electric Association for use under the rules and regulations of the National Board of Fire Underwriters. In every case, illustrations are given, together with the rating of the apparatus, the manufacturer's name and address, and a digest of the rule relating to the device. This list will no doubt prove of great interest and value to users of electrical supplies. It is a compilation which has long been needed in the construction department of the electrical industry. The list is revised annually and published in October, and sells for fifty cents per copy.

EXPORTERS' ENCYCLOPEDIA—The Exporters' Encyclopedia for 1907 has been published by the Exporters' Encyclopedia Company, Maritime Exchange Building, New York city. This encyclopedia is a complete guide for export shipping, devoted to the interests of the American manufacturer and export shipper. It includes 650 pages, and, bound in cloth, sells for $5 per copy. The volume contains authentic and detailed shipping instructions for every country in the world. There are also given the names and addresses of all the transportation companies, both steam and sail, from New York, Philadelphia, Boston, Baltimore, New Orleans, Galveston and other coast cities. Ports of call are given, and every point for which bills of lading may be obtained is listed. The prominent inland cities and towns are defined, with directions how to reach them and the time between principal places. The arrangement of consular documents is explained, giving consular charges and showing *fac simile* consular invoices with English translations for all countries. Instructions are also given concerning packing, marking and shipping, the insurance and consigning of shipments, and the arrangement of bills of ladings, custom-house clearances and other forms.

NEW INCORPORATIONS.

CHARLESTON, S. C.—The Columbia Rural Telephone Company. $1,000. President, Joseph B. S. Lyles; secretary, E. L. Craig.

ST. PAUL, MINN.—Farmers' Telephone Company, of Rockwood. $10,000. Incorporators: D. W. Thurston, Isaac Foster and C. B. Barnes.

AUGUSTA, ME.—Transcontinental Electric Railway Company, organized at Portland. To build electric railways anywhere in the United States. $50,000,000.

AUSTIN, TEX.—The Corsicana Telephone Company, of Corsicana. An amendment to its charter increasing its capital stock from $50,000 to $100,000.

WHEELING, W. VA.—Wheeling, Sherrard & Cameron Intersuburban Electric Railway Company. To build an electric line through Marshall county, W. Va. $25,000.

MADISON, WIS.—The Matteson Telephone Company, town of Matteson, Waupaca county. $6,000. Incorporators: L. A. Burgess, G. G. Fergot and Noyes Matteson.

FRANKFORT, KY.—White City Electric Light, Heat and Power Company, changing name to Jefferson County Electric Company, and reducing capital stock from $300,000 to $75,000.

GUTHRIE, OKLA.—The Guymon & Hansford Telephone Company, of Guymon, $7,000. Incorporators: R. B. Quinn, S. C. Tyler, D. F. Vincent, G. W. Baird and E. C. Summers.

SPOTSYLVANIA, VA.—Spotsylvania Telephone Company. $10,000. Incorporators: G. W. Perry, J. P. H. Crismond, T. A. Harris, T. W. Dew, W. B. Warren, C. R. Coleman and associates.

GUTHRIE, OKLA.—The Beaver & Cimarron Valley Telephone Company, of Zelma. $5,000. Incorporators: A. J. Sands, Otto Barbey and W. L. Detwiller, of Zelma; F. M. Wells, of Coin, and C. W. Newby, of Englewood.

MILWAUKEE, WIS.—Milwaukee & Fox River Valley Railway Company, Milwaukee. An amendment increasing the capital stock from $25,000 to $75,000; $50,000 of the stock to be preferred with a dividend of six per cent.

CARSON, NEV.—Interurban Electric Company. To build an electric line from Reno to Moana Springs. $50,000. Incorporators: Richard Kirkman, A. Armanko, James May, S. H. Rosenthal, C. J. Sadlier, William Walts, Louis Berrum, John N. Evans and J. S. Short.

HARRISBURG, PA.—The Prospect Park Railway Company. To build a line from Prospect Park to Morton and Springfield, two and a half miles long; $25,000. The Sharon Hill & Upper Darby Railway Company, seven miles long; $50,000. The Tinicum & Sharon Hill Railway Company, four miles long; $25,000. Walter A. Rigg, of Reading, is president of the three roads.

ALBANY, N. Y.—The Delaware & Otsego Independent Toll Line Company. To operate a telephone line through Treadwell, thence to Frasiers, thence to Andes and to Margaretville; also a line from Frasiers to Delhi, thence to Walton and thence from Treadwell to Franklin; and lines from Oneonta to Milford, thence to Cooperstown and from Cooperstown to the Mohawk valley. $15,000. Directors: T. Harvey Ferris, H. A. Harrison and Delia D. Harrison, all of Utica; H. D. Arbuckle, F. C. Ward, L. C. Millard and Ralph Stoddard.

AUGUSTA, ME.—Lisbon, Durham & Freeport Street Railway Company; to build a road from Lisbon through Durham to Freeport, nine miles; directors: Cyrus W. Davis, of Waterville, Edwin J. Lawrence, S. A. Nye, A. B. Page and Amos F. Gerald, of Fairfield. Mt. Desert Transit Company; to construct a railroad from Ellsworth through Trenton, Eden, Mt. Desert and Tremont to Southwest Harbor, a distance of forty miles; $160,000; directors: Clement Newbold, of Philadelphia; John J. Kennedy, of New York; George B. Dorr, Robert Amory and Fred C. Lyman, of Eden.

TELEPHONE AND TELEGRAPH.

SPOKANE, WASH.—The Home Telephone Company has issued $500,000 bonds.

GREENFIELD, MASS.—The New England Telephone and Telegraph Company will extend its line from Amherst to Greenville.

PITTSFIELD, MASS.—A telephone exchange is to be installed in Sheffield by the New England Telephone and Telegraph Company.

NEWTON CENTRE, MASS.—The new exchange of the New England Telephone and Telegraph Company has been placed in operation.

CLARKSBURG, W. VA.—The Bell company is said to have gained control of the independent line between Winfield and Morgantown.

MAPLETON, ME.—The Aroostook Telephone Company has erected a line from Presque Isle to Fort Kent by way of Ashland and Portage Lake.

NASHVILLE, TENN.—The directors of the Cumberland Telephone and Telegraph Company have voted to issue $3,300,000 additional stock to stockholders of record January 15, payable in four instalments on the first day of February, April, July and October.

CLEVELAND, OHIO—The Bell Telephone Company has purchased the property adjoining its Champlain avenue building. This contains a four-story brick and stone structure. The purchase has been made necessary by the fact that the company has outgrown its present quarters.

CHARLESTON, W. VA.—George B. Shank, of Burlington; A. A. Welton, Williamsport; G. P. Miller, of Romney; C. D. Bowman, of Moorefield; Dr. F. L. Baker, of Burlington, and L. J. Forman, of Petersburg, W. Va., have incorporated a telephone company with a capital of $6,000. The company will build lines through the counties of Mineral, Hampshire, Grant and Hardy.

EAU CLAIRE, WIS.—The Eau Claire County Telephone Company has elected the following officers for the ensuing year: E. E. Tobey, Union, president; Walter Hobbs, Union, vice-president; E. W. Cheney, Eau Claire, secretary and treasurer. The company now has eighty telephones on its lines, and expects to increase this by spring to 100. A trunk line will be built in the spring to connect with the Wisconsin Telephone Company.

RALEIGH, N. C.—The stockholders of the Bell and Interstate Telephone Companies have united under the name of the Capital City Telephone Company, with $200,000 capital stock. W. T. Gentry, of Atlanta, of the Bell Company, was elected president; L. A. Carr, of Durham, of the Interstate Company, vice-president. These and George W. Watts and Julian S. Carr, of Durham; A. B. Andrews, Jr., of Raleigh; A. Maupin and Hunt Shipley, of Atlanta, were made directors.

BOSTON, MASS.—The Worcester County Home Telephone Company has filed a request at the state house in Boston for incorporation under Massachusetts laws. Its paid-in capital is but $5,000, but that is nominal and will be increased as soon as its franchises give it holdings of value. Petitions have been filed with the board of aldermen of Worcester and Fitchburg and the selectmen of Leominster, Clinton and Gardner. The incorporators have chosen these officers: president, William H. Cook, treasurer of the George C. Whitney Manufacturing Company; vice-president, Richard Healy; treasurer, Charles F. Marble, cashier of the Curtis & Marble Machine Company; directors, the officers and Paul B. Morgan, treasurer of the Morgan Construction Company and the Morgan Spring Company; Alonzo W. Whitcomb, president of the Whitcomb-Blaisdell Machine Company; Samuel E. Winslow, president and treasurer of the Samuel Winslow Skate Manufacturing Company. It is proposed to file other petitions for franchises in the smaller towns of the county to get connection between the stated places as soon as franchises are obtained in the larger centres of population.

ELECTRIC LIGHTING.

JUNEAU, WASH.—Douglas business men will organize an electric light company.

HAMLET, N. C.—The local electric light plant has been sold to C. Gresham and J. A. Williams.

PARSONS, TENN.—The Parsons Marble and Granite Works will install electric lights in Parsons.

PEORIA, ILL.—The city council has passed an ordinance granting to the Peoria Gas and Electric Company a forty-year electric franchise.

BALTIMORE, MD.—The Rockdale Power Company has purchased additional property at Hoffmansville, and will erect a large electric plant.

WILMINGTON, DEL.—Additional machinery has been installed by the Wilmington City Electric Company to meet the increased demand for current.

SPOKANE, WASH.—Work has been started by the Trent Power and Irrigation Company on the power plant which is to be built at Trent, eight miles east of Spokane.

BRIDGEVILLE, DEL.—Bridgeville is to be lighted with electricity, and poles are now being erected. Wires will be strung from Seaford, which town is lighted by the Laurel company.

HAZLETON, PA.—The Consumers' Electric Light and Power Company has been given permission to erect poles, maintain wires and lay conduits along the streets and alleys of West Hazleton.

LITTLE FALLS, N. Y.—The sale of the holdings of the Herkimer County Light and Power Company, of Little Falls, to the Anthony N. Brady interests, of Albany, has been officially announced.

MOBILE, ALA.—Permanent surveys have been begun for the power plant of the Little River Company, and final plans have been made for the power plant of the Mussel Shoals Hydroelectric Company.

ELLENVILLE, N. Y.—It is reported that a number of Ellenville men have bought the water rights of Eugene Smith, on the Neversink, and will erect a plant to supply Ellenville with electric light and power.

FREDERICKSBURG, TEX.—G. A. Pfeil has bought the electric light plant from Christian Stehling, the consideration being $7,000. Mr. Pfeil will buy a larger dynamo, overhaul the machinery and make the plant up to date.

FULTON, N. Y.—The Fulton Light, Heat and Power Company, of Fulton, has made application to the state commission of gas and electricity for permission to issue $150,000 of preferred stock for extensions and betterments.

ENGLISH, IND.—Municipal ownership of the electric light plant has not proved a success in English and the town board has sold the plant to a private company. The plant was built by the town five years ago and proved a losing venture.

BLUFFTON, IND.—The city council has purchased three new boilers for the city electric light and waterworks plant, at a cost of $4,350. The boilers are each of 150 horse-power, and are to be added to the equipment within the next three months.

FARLEY, IOWA—The city of Farley is considering the proposal of putting in an electric light plant. The matter has been delayed up to the present by a suit for damages against the city which was pending, but which is now satisfactorily settled.

DANVILLE, IND.—The Danville electric light plant, owned by James H. Wilson, has been sold to James M. Lynch. The consideration is said to have been $5,000. Mr. Lynch is a practical electrician, having erected the plant at Plainfield. He will remodel the Danville plant.

MONTGOMERY, ALA.—The Alabama Power Company, of Gadsden, Etowah county, a corporation formed for the purpose of supplying power and lights, has filed a certificate of incorporation with the secretary of state. The incorporators include W. P. Lay, Earl Lay and O. R. Hood.

HAMBURG, N. Y.—The town board has granted a limited franchise to the Niagara, Lockport & Ontario Power Company for

twenty-five years to supply power, light and heat. The grant is free for fifteen years, after which the town is to receive one per cent of the gross receipts for the balance of the term.

CANAJOHARIE, N. Y.—The board of trustees of Palatine Bridge has made a contract for five years, dating January 1, 1907, with the Montgomery Electric Light and Power Company, for ten arc lights at $50 per light per year. Under the old contract with the same company, Palatine Bridge paid $70 a light.

SCRANTON, PA.—When the appropriation committee of councils met in 1905 the sum of $62,999 was appropriated to care for 863 city electric lights. During the year 1906 there was forty additional lights placed, which at $73 per year means an additional charge in 1907 of $2,920.

BAKER CITY, ORE.—It is announced that all of Isaac Anderson's electric light and power plants have consolidated under one management with A. L. Welch president and manager. The plants include those of Eugene, Springfield, Albany, Cottage Grove, Corvallis, Seaside, Roseburg, Baker City and Pendleton, Ore.. and Walla Walla, Wash.

PELHAM, GA.—The city of Pelham will install electric lights, waterworks, a sewerage system and an ice plant, all to be owned and operated by the city. H. S. Jaudon, of Savannah, and Ludwig & Company, of Atlanta, have been selected as the consulting engineers. Work will be begun at once and will involve an expenditure of about $50,000.

SCHENECTADY, N. Y.—By a unanimous vote the common council adopted a resolution directing the board of contract and supply to enter into a new contract with the Schenectady Illuminating Company in accordance with a schedule submitted by the company. This new schedule will result in a saving to the city of over $10,000 per year.

AUSTIN, TEX.—At a special meeting of the city council the proposition of William F. Ellis and associates to lease the water and light plant for a period of fifty years, the lease to carry with it the franchise for the rebuilding of the dam across the Colorado river, was rejected, the report of the water and light committee to that effect being adopted.

ELYRIA, OHIO—The Elyria Milling and Power Company has notified the city council that it would accept the conditions of the franchise recently granted to it for the construction of poles and wires in the streets and alleys of the city. The acceptance was accompanied by a bond of $5,000. The company will start as soon as the weather permits to erect its pole lines.

BROWNSVILLE, TEX.—Word has been received from James Stillman, president of the City National Bank, of New York, and owner of a great amount of city property in Brownsville, including the International ferry, offering to donate a site for electric light and waterworks plant shortly to be installed. He proposes to donate the site wherever it may be chosen by the company, and in addition will make a donation in money.

EASTON, PA.—Sixty of the leading men and business firms of Easton have sent a petition to the select council of that city urging the council to advertise for bids for lighting the streets of the city and for bids to keep the city's lighting plant in operation and repair while a private corporation is preparing to light the city. This action is the outcome of the constant complaint about the service given by the municipal plant, which is run at a loss of from $4,000 to $5,000 a year.

CHARLOTTE, N. C.—The Rockingham Power Company will be ready to deliver power from Bluitt Falls, on the Pee Dee river, by January 1, 1908. There are more than 500 men engaged upon the work. A spur track has already been built from Pee Dee station on the Seaboard Air Line Railroad near Rockingham, to the falls, a distance of three and one-half miles. The total cost of the development will be in the neighborhood of $2,000,000. Approximately 30,000 horse-power will be developed.

GRANVILLE, N. Y.—At the annual meeting of the Granville Electric and Gas Company the following directors were chosen: B. G. Higley, F. D. Howland, George Tait, of Sandy Hill; Edgar T. Brackett, of Saratoga; E. R. Norton, H. J. Stevens, F. S. Fogg, of Granville. The directors held a subsequent meeting and chose the following officers: president, B. G. Higley; vice-presidents, George Tait and F. T. Pember; treasurer, H. J. Stevens; secretary and manager, F. S. Fogg.

SOUTH PARK, WASH.—The South Park council has awarded the contract for the lighting of the city's streets to the Seattle Electric Company, with the understanding that the company will begin the work at once and will have fifteen lights installed within thirty days. By the terms of the agreement the Seattle Electric Company will install twenty-five thirty-two-candle-power lights at the principal street crossings of the city and furnish power at the rate of $2 a month for each light. The contract is to cover a period of five years.

ST. PAUL, MINN.—The assembly has passed the electric franchise ordinance of the Northern Heating and Electric Company just as it was received from the aldermen. The ordinance will become effective with the mayor's signature, and it is said that the company will begin work on its electric lighting system as soon as possible. It is provided in the ordinance that eleven miles of conduits and overhead wires shall be completed and in service within three and one-half years after the date of acceptance of the ordinance. The company now has conduits in a number of down-town streets.

BALTIMORE, MD.—The county commissioners of Baltimore county have awarded a five-year contract for lighting Catonsville to the Baltimore County Water and Electric Company. The bid was $11.40 for twenty-five-candle-power incandescents, and $57 for 2,000-candle-power arcs. The only other bid was from the Patapsco Electric and Manufacturing Company, which asked $12 for the incandescents and $65 for the arcs. There are forty arc lamps and 326 incandescent lights in Catonsville, so that the cost is $5,996.40. Bids were asked for both a two-year and a five-year contract. By adopting the five-year contract a saving was made of more than $500.

MORRISTOWN, N. J.—At a meeting of a number of business men preliminary arrangements were made for the formation of a company to build a combined electric and gas plant. The company is to have a capital of $200,000. It is planned to issue stock only in limited amounts to each subscriber, that the company may be as representative of the business interests of the town as possible and not be controlled by outsiders. After paying dividends of five per cent upon the stock and a percentage for depreciation into a sinking fund, the profits will be paid into the city treasury. The city will be asked to engage an expert to look into local conditions and fix a fair price for electric current and gas.

TOPEKA, KAN.—The city has recived the report of George M. Brill, who was engaged by the council to investigate the probable cost of rebuilding the city electric light plant according to present needs for lighting the streets. Mr. Brill furnished two estimates, one of the cost of remodeling the present plant and one for entirely rebuilding it. The first and cheaper method will cost $65,000 and the second will foot up a total of $102,500. The first figures include the purchase of 200 open arc lamps and their installation, which item amounts to $30,000. The second plan calls for the purchase of new enclosed arc lamps throughout and consequent engineering work which will cost $49,000 of the $102,500.

WILMINGTON, DEL.—At a meeting of the street and sewer department a resolution was adopted granting the electric portion of the franchise of the Commercial Light, Heat and Power Company to the Delaware Electric Transmission Company. Under the resolution granting the Delaware company an electric franchise it agrees to assume one-half of the obligations of the Commercial Light, Heat and Power Company in reference to the payment of money to the city. Each company will now pay the city $18,750, the Commercial company having already paid $12,500 of the $50,000 required. The new company is also to give the city an indemnifying bond and to pay three per cent of its gross receipts to the city. In case it secures a contract for street lighting it is also to furnish 500 arc lights at $40 per year each. Of the $18,500 to be paid the city $6,250 is to be paid within six months from date, a like amount in twelve months and the balance in eighteen months, which is practically an extension of time for paying the $50,000 required for the gas and electric franchise. The other conditions of the franchise are the same as granted to the Commercial company.

INDUSTRIAL ITEMS.

THE MICHIGAN CENTRAL (the Niagara Falls route) has published a handsome calendar, the illustration showing Niagara Falls from the Michigan Central trains.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, is distributing a beautiful calendar, the illustration being a study by Asti, entitled "Thelma." Copies of this calendar can be secured from the company for fifty cents.

THE WIRE AND TELEPHONE COMPANY OF AMERICA, Rome, N. Y., announces the election of officers at its stockholders' meeting, held on January 8, as follows: president, Oliver Shiras; vice-presidents, F. M. Potter, Jr., and S. C. Houghton; secretary and treasurer, H. T. Dyett.

THE PROMETHEUS ELECTRIC COMPANY, 236-238 East Forty-third street, New York city, has a new series of literature devoted to its electric heating and cooking apparatus ready for distribution. The Prometheus apparatus covers a wide range of devices, not only for domestic purposes but for all kinds of industrial adaptations as well.

THE H. KRANTZ MANUFACTURING COMPANY, Brooklyn, N. Y., has ready for distribution a new catalogue descriptive and illustrative of its panelboards. The company will be pleased to send this catalogue to any one interested upon request. The company is also distributing a binder in which all its publications may be kept in convenient form.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago, Ill., has ready for distribution a new catalogue descriptive of wireless clusters and lighting specialties. This is very completely illustrated, and in addition to the descriptions of the apparatus gives details concerning sizes and list prices. This catalogue will be sent to any one interested upon request.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has been awarded the contract for the electrical machinery for the municipal lighting plant for the city of Orange, N. J. The town of Brookhaven, Miss., has also awarded a contract for the electrical machinery for a new lighting plant. The company is distributing an attractive calendar for 1907, illuminated with a fine lithograph in colors showing the company's works at Ampere. This gives a good idea of the extensive facilities which this company has for the manufacture of its electrical products.

THE LOCKE INSULATOR MANUFACTURING COMPANY, Victor, N. Y., has ready for distribution catalogue No. 9, the "Insulator Book" for 1907. The announcement states that the development of electric power transmission during the two years since the issue of the previous catalogue, No. 8, is shown, in a manner, by the revision of many of the insulator designs, the use of many new designs, and the dropping from use of others. In compiling this catalogue the endeavor has been made to present only such material and data as have withstood the test of actual service, and while it is desired to represent only the most advanced practice, it has been deemed wise to use great care and conservatism in recommendations in order to better protect the company and its customers.

THE DU BOIS IRON WORKS, Du Bois, Pa., a million-dollar corporation, has taken over the entire business of the Lazier Engine Manufacturing Company, Buffalo, N. Y. The Du Bois Iron Works has been manufacturing gas and gasolene engines for some years under the patents and designs of Arthur A. Lazier, formerly vice-president and general manager of the Lazier Engine Manufacturing Company, who has sold out his entire interest and retires from the business management and company. Peter Eyermann, a German designer and engineer, will be chief of the engineering department. The company will continue the manufacture of its "Simplex" steam pump. The officers of the company are: John E. Du Bois, president; W. C. Bentz, vice-president; E. A. Badger, secretary and treasurer; I. N. Hamilton, general manager. The sales and advertising department will be in the hands of C. E. Stuart. The head office will be located at Du Bois, Pa. At Buffalo, the former headquarters of the Lazier Engine Manufacturing Company, a branch office will be maintained.

Record of Electrical Patents.

Week of January 8.

840,478. PROTECTIVE APPARATUS FOR ELECTRICAL CIRCUITS. Harry P. Davis, Pittsburg, and Frank Conrad, Edgewood Park, Pa., assignors to Westinghouse Electric and Manufacturing Company. A circuit-breaker for parallel distributing lines depending for its action upon the unbalancing of the lines.

840,479. PROTECTIVE APPARATUS FOR PARALLEL TRANSMISSION LINES. Harry P. Davis, Pittsburg, and Frank Conrad, Edgewood Park, Pa., assignors to Westinghouse Electric and Manufacturing Company. A circuit-breaker for parallel transmission lines actuated by a polyphase motor.

840,480. APPARATUS FOR RECOVERING METALS FROM ORES AND OTHER SUBSTANCES. Léon Dion, New York, N. Y., assignor to the Americus Electro-Hermetic Company, New York, N. Y. The ore is passed through a series of chambers each containing an electric arc.

840,481. ELECTRIC FURNACE. Léon Dion, Wilkesbarre, Pa., assignor to the Americus Electro-Hermetic Company, Wilkesbarre, Pa. A number of chambers are provided, each containing a set of electrodes.

840,508. TELEGRAPHIC APPARATUS. Thomas W. McKenzie, Kenton, Manitoba, Canada. An automatic caller for telegraph lines.

840,511. EXTRACTING METALS FROM SULPHIDE ORES. Robert L. Packard, Washington, D. C. Unroasted pulverized sulphide ore is electrolized in an acid bath capable of yielding chlorine.

840,516. SWITCHING ARRANGEMENT. Otto Rennert, London, England. A step-by-step method of cutting in and out a number of sources of electric currents.

840,531. ELECTROMAGNET. Thomas M. Walsh, Rochester, N. Y., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. A method of mounting a coil.

840,537. SWITCHBOARD. Welby D. Weir, Winnsboro, Tex. A number of panels, each containing circuit-closing rings, are mounted together for receiving connecting plugs.

840,544. PARTY-LINE TELEPHONE MECHANISM. Charles H. Wood, Cleveland, Ohio, assignor of one-fourth to John T. Hobbs, Cleveland, Ohio. The circuit at the called station is closed by a pawl and rachet.

840,557. AUTOMATIC CIRCUIT-CONTROLLING MECHANISM. Herbert G, Crawford, Elmont, Va. A delicately balanced needle is brought into contact with any one of a series of terminals by a deep-pressing member.

840,569. ELECTRICAL MEASURING INSTRUMENT. John M. Lea, Chicago, Ill., assignor to International Electric Meter Company, Chicago, Ill. A compound voltmeter and ammeter, separate needles moving over the same scale-plate.

840,582. ELECTRIC ALARM DEVICE. John F. O'Neill, Newburgh, N. Y. An overflow alarm for ice-boxes.

840,589. TELEPHONE SIGNAL. Gustavus W. Schuessler, Mason, Tex. A visual indicator.

840,590. ELECTRIC MOTOR CONTROLLER. Simon Sparrow, St. Louis, Mo., assignor to Wagner Electric Manufacturing Company, St. Louis, Mo. An automatic stop and reversing switch are controlled by fluid pressure produced by the motor itself.

840,614. ELECTRIC CIRCUIT-BREAKER. Stanley B. Freiberg, Cincinnati, Ohio. A method of constructing a circuit-breaker.

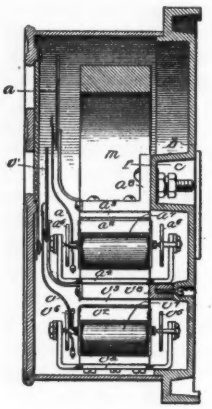
840,634. ELECTRICAL CONDUCTOR FOR LIGHTING PURPOSES. Isador Ladoff, Schenectady, N. Y., assignor, by direct and mesne assignments, to Philip C. Peck, New York, N. Y., and Anna M. Ladoff, Schenectady, N. Y. An arc-light pencil consisting for the most part of an alloy of titanium with another metal having a higher conductivity.

840,648. TROLLEY WHEEL. James A. Nortan, Wilkesbarre, Pa., assignor of one-half to William L. Raeder, Wilkesbarre, Pa. The hub is provided with an interior lubricant chamber.

840,649. TROLLEY-POLE CONNECTION. Jacob M. Olinger, Springfield, Ohio. A trolley-pole base and spring.

840,699. TELEPHONE OPERATOR'S SWITCHING DEVICE. William Kaisling, Chicago, Ill., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Flat switch-springs are provided, the circuit being closed by vertical keys.

840,714. TOOL FOR TESTING THE CURRENT IN ELECTRIC WIRES. Alfred Scheibler, Aarau, Switzerland. A device for placing a fuse across the wires.



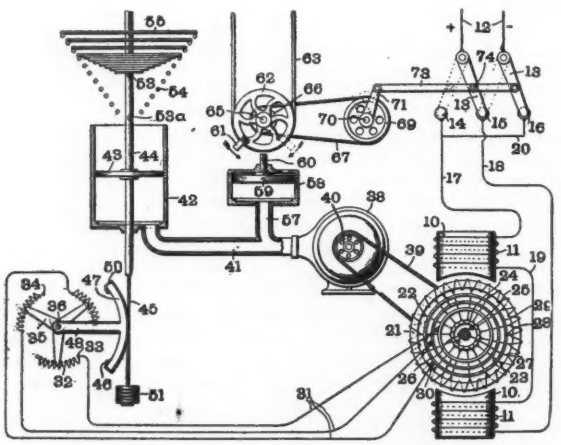
840,569.—ELECTRICAL MEASURING INSTRUMENT.

840,721. VARIABLE-SPEED DRIVING. Victor O. Strobel and Arthur E. Hogrebe, Philadelphia, Pa., assignors to Niles-Bement-Pond Company, Jersey City, N. J. Two electric machines are geared to the mechanism, one running as a motor, the other as a generator.

840,726. TELEPHONE EXCHANGE SYSTEM. Harry G. Webster, Chicago, Ill. The high-resistance line signal is disconnected when a connection is established.

840,728. ELECTRIC INDUCTION BATTERY. Halle E. Willis, Lebanon, N. H., assignor to Kendrick & Davis, Lebanon, N. H. The circuit interrupter is mounted so that it yields in all directions.

840,746. PARCEL CARRIER. Arthur S. Bretherton, Cleveland, Ohio. A small electric railway.



840,590.—ELECTRIC MOTOR CONTROLLER.

840,767. CLOTH-CUTTING MACHINE. John B. Gury, St. Louis, Mo. A motor-driven circular knife.

840,802. ELECTROSTATIC SEPARATOR. Greenleaf W. Pickard, Amesbury, Mass., assignor to Huff Electrostatic Separator Company, Boston, Mass. A number of small attracting electrodes are opposed to the large repelling electrode.

840,815. ELECTROSTATIC SEPARATOR. Philip H. Wynne, Boston, Mass., assignor, by mesne assignments, to Huff Electrostatic Separator Company. The electrodes are charged intermittently.

840,848. CIRCUIT-BREAKER. Edward M. Hewlett, Schenectady, N. Y., assignor to General Electric Company. A pivoted handle forms part of a toggle to hold the breaker closed.

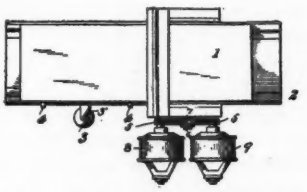
840,857. ELECTRIC HEATER. Nicholas N. S. Matcovitch, San Francisco, Cal., assignor to J. Earl Moore, Los Angeles, Cal. A long flexible heating element secured between a pair of blankets.

840,866. ELECTRICALLY PROPELLED VEHICLE. Mathias Pfatischer, Philadelphia, Pa., assignor to Russell Thayer, Philadelphia, Pa. A vehicle running either on an electric railway or on a trackless roadbed.

840,889. STARTING RHEOSTAT. William C. Yates and Paul H. Zimmer, Schenectady, N. Y., assignors to General Electric Company. A quick break is made in passing from each contact.

840,908. SPACE TELEGRAPHY. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. The receiving system is connected to a point on the elevated conductor system which is at ground potentials.

840,909. SPACE TELEGRAPHY. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. The receiver is thrown out of action by the sending-key.



840,721.—VARIABLE-SPEED DRIVING.

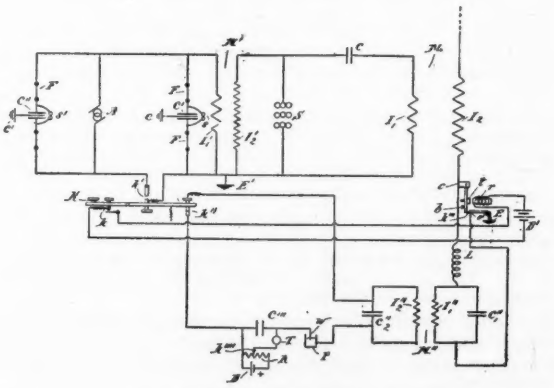
840,915. BATTERY BINDING-POST. George H. Cove, Roxbury, Mass., assignor, by direct and mesne assignments, of one-half to Frank R. Kimball and one-half to Hampton V. Hayward, Boston, Mass. A spring clamp.

840,947. TOWER FOR ELECTRIC TRANSMISSION CABLES. Albert K. Mansfield, Batavia, Ill. A method of constructing an angle iron tower.

840,987. TELEGRAPH RELAY. William E. Athearn, New York, N. Y., assignor to American Telephone and Telegraph Company. The movable armature is placed between opposed poles.

840,995. METHOD OF POLYSTATION SIGNALING. William W. Dean, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. A selective harmonic signaling system.

841,004. INTERRUPTER FOR ELECTROMAGNETS. John Erickson, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. A spring switch and means for releasing it.



840,908.—SPACE TELEGRAPHY.

841,033. TELEPHONE EXCHANGE SYSTEM. Frank J. Mersman and Joseph Mersman, Ottawa, Ohio. A selective signaling system, one line being continuous and the other interrupted at each station.

841,035. ELECTRICAL SWITCH. John E. Morris, Columbus, Ohio, assignor of one-half to Edward Glaze, Columbus, Ohio. A cam switch.

841,064. TELEGRAPH AND TROLLEY POLE. Thomas P. Stanley, Athens, Ga. A reenforced pole.

841,076. TRANSFORMER. Harry P. Davis, Pittsburg, and Frank Conrad, Swissvale, assignors to Westinghouse Electric and Manufacturing Company. The secondary is wound on a third leg having an air-gap in the magnetic circuit.